AUGUST
1962

PRICE 75 CENTS

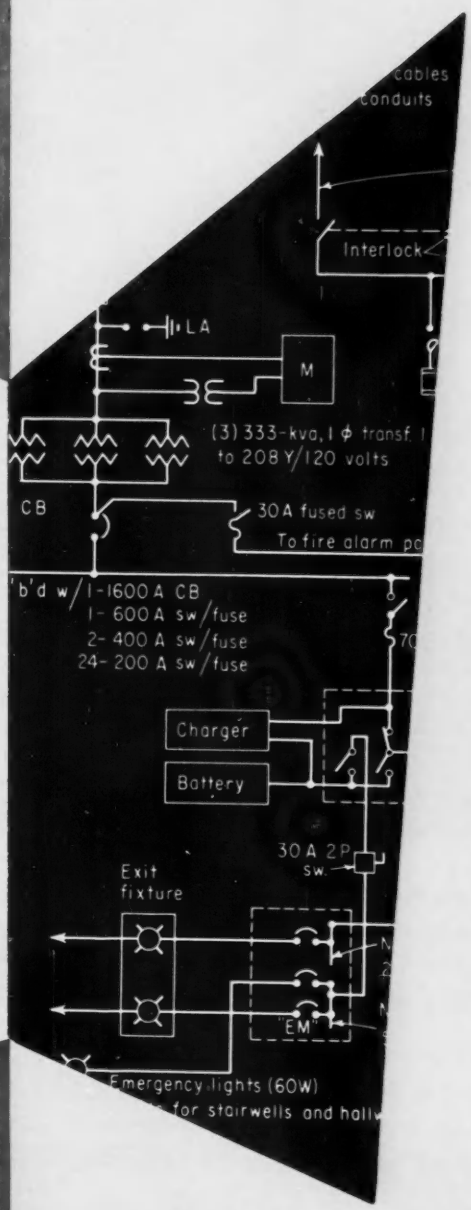
ELECTRICAL CONSTRUCTION AND MAINTENANCE

WITH ELECTRICAL CONTRACTING

MAJOR 1962 NATIONAL ELECTRICAL CODE CHANGES

EFFECTIVE MOTOR BEARING MAINTENANCE

PRIMARIES UNDER SIDEWALKS



A McGRAW-HILL PUBLICATION | 61ST YEAR

n. c. gratelite offers all the advantages of a louver diffuser plus it's *NON-COMBUSTIBLE*

Guth N.C. (for Non-Combustible) Gratelite Louver Diffusers(1) are molded of non-combustible plastic—listed by Underwriters Laboratories, Inc. as NON-COMBUSTIBLE with a low 25 U.L. flamespread rating.

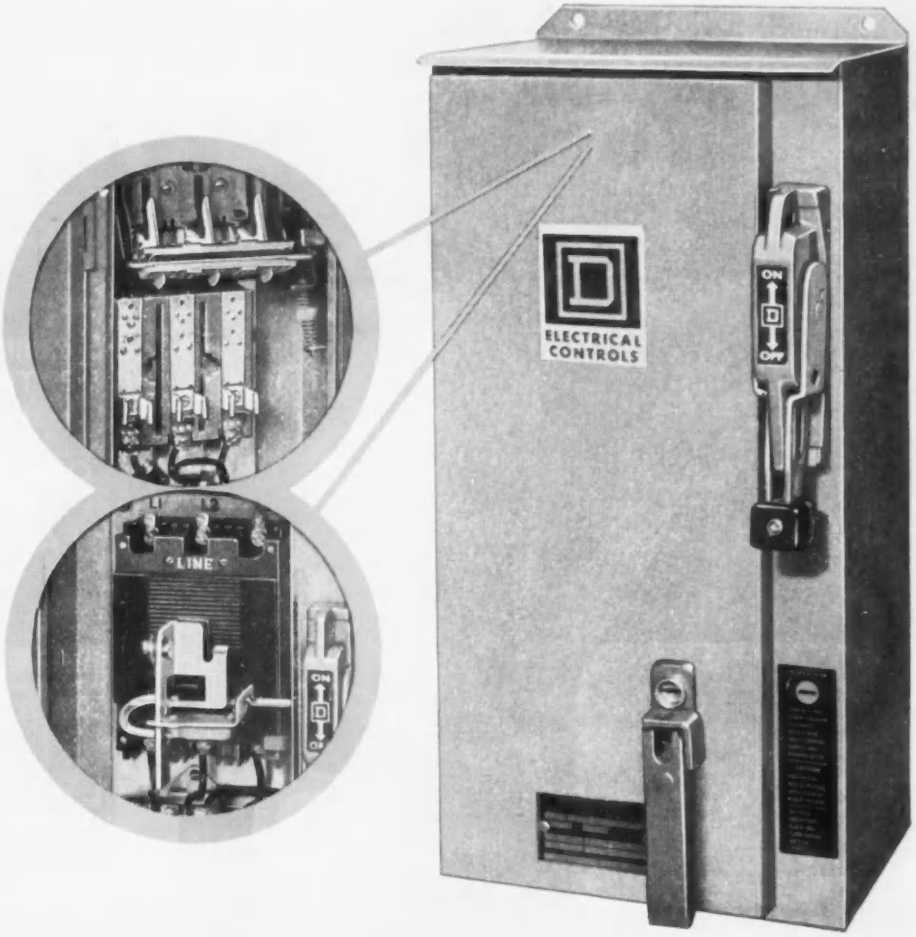
Supported by Guth Una-Tee System, N.C. Gratelite in overall electric ceilings can't fall out and cause panic. Also, building insurance rates may be substantially reduced with N.C. Gratelite Illuminated Ceilings.

N.C. Gratelites feature built-in breathing action for complete flow of air through open ⅜" cubes—fixtures and lamps operate cooler; dust, bugs and dirt drop through. Sprinkler systems, heating and air conditioning ducts can be mounted above open ⅜" cubes. Supreme rigidity of N.C. Gratelites minimizes chance of buckling, sagging and warping in ceilings. Plus, N.C. Gratelite is non-electrostatic—repels dust and dirt for easier maintenance. N.C. plastic is light stabilized.

write today for our N.C. GRATELITE brochure

THE EDWIN F. GUTH COMPANY, 2615 WASHINGTON BOULEVARD, ST. LOUIS 77, MISSOURI

(1) LISTED BY U.L. ® U.S. PAT. NO. 2,745,001. CAN. PAT. NO. 538,245



NOW!

Both SWITCH *and* BREAKER types!

PLUS

all the features that make the
Square D combination starter

THE SAFEST OF ALL!

GET THE FULL STORY! Write for Bulletin SM-292 to find out why Square D starters are so safe, so reliable, so easy to use. Square D Company, Dept. SA, 4041 North Richards Street, Milwaukee 12, Wisconsin.

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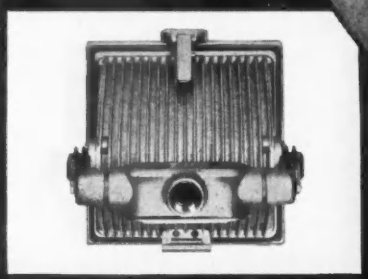
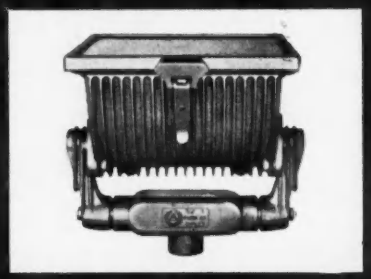
Aluminum
WEATHERPROOF
Housing





ALL NEW—ALL DIFFERENT

the finest Quartzlite 500 You Can Buy!

This Appleton Quartzlite 500 utilizing the powerful 500 watt Quartz-Iodine Lamp, stands out above all others on the market. It has exclusive features found in no other unit and is engineered to give more trouble-free service outdoors or in, than ever before possible.

HERE'S WHY!

The new Appleton Quartzlite 500 has an exclusive one-piece cast aluminum housing heavily finned for heat dissipation and exceptional rigidity. A new weatherproof self-locking cover is fitted with a special one-piece moulded silicone rubber gasket that will prevent the entrance of moisture even if the latch should be left open, or jolted open by accident.

Mounting may be made directly to ¾" rigid conduit because of the compact, light weight design and construction. Three efficient beam spreads are available: wide, medium and narrow.

Your Appleton Franchised Distributor will give you all the details. Call him for immediate service.

APPLETON ELECTRIC COMPANY
1701 Wellington Avenue
Chicago 13, Illinois

APPLETON®

ELECTRICAL CONSTRUCTION AND MAINTENANCE

with which is consolidated Electrical Contracting, The Electragist and Electrical Record — Established 1901

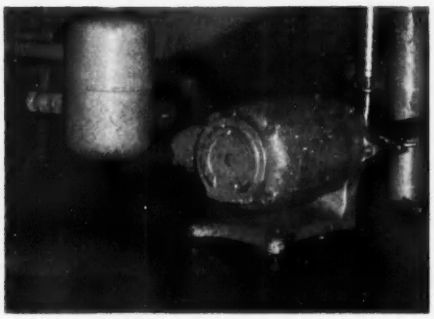
Published for electrical contractors, electrical departments in industry, engineers, consultants, inspectors and motor shops. Covering engineering, installation, repair, maintenance and management in the field of electrical construction and maintenance.

61ST YEAR • AUGUST 1962

SILICONE NEWS from Dow Corning

Upgrade motor enclosures

Specify Silastic RTV encapsulation for longer service life from motors



For motors in *hot* water — in *cold* water — in *any environment* that causes frequent failure — encapsulation with Silastic® RTV silicone rubber offers superior protection for windings . . . multiplies motor life.

Take a tip from a midwest dairy. Subjected to daily equipment wash-downs, a milk-pump drive-motor failed monthly. Then the windings were encapsulated with Silastic RTV . . . and failures ended. That was nearly two years ago! Motor life was multiplied twenty times and more.

Silastic RTV is resilient — expands and contracts with the windings and laminations — won't crack or craze even during rapid thermal cycling. Silastic RTV remains rubbery over the wide temperature range of —70 to 180 C. Windings *stay sealed* in the protective jacket that's impervious to moisture, abrasive dusts and corrosive atmospheres.

Specify encapsulation with Silastic RTV to upgrade enclosures on your class A, B, F or H motors. This protection is available from nearly two hundred motor service shops throughout the nation. They identify themselves with the emblem at right.

For a list of these shops, and more information about Silastic RTV encapsulated motors, write Dow Corning Corporation, Dept. 3108, Midland, Michigan.

first in silicones

Dow Corning

ELECTRICAL CONSTRUCTION AND MAINTENANCE

AUGUST • 1962 *continued*

Vol. 61, No. 8 ELECTRICAL CONSTRUCTION and MAINTENANCE AUGUST 1962

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Sidelights

NEW CODE

The forthcoming 1962 edition of the National Electrical Code is scheduled to be issued next month (September). It will contain nearly 300 revisions of past rules and new rules. There are four new Articles and several completely revised Articles. Associate Editor John H. Watt has been following the development of the new code closely and has prepared a special report for our readers covering the most significant changes. His timely and authoritative study "Highlights of the 1962 National Electrical Code" leads our editorial feature section this month beginning on page 75.

UNDER SIDEWALK DISTRIBUTION

A novel system of precast concrete troughs with cover slabs forming the sidewalks of a community development near Seattle, Wash., eliminates pole lines and allows full accessibility to the primary cable distribution system. In view of the growing interest in poleless community planning, the under sidewalk installation by Industrial Electric of Seattle is a development of considerable importance in these times. The installation is described in "Primaries Under Sidewalks" beginning on page 83.

115-KW RESIDENCE

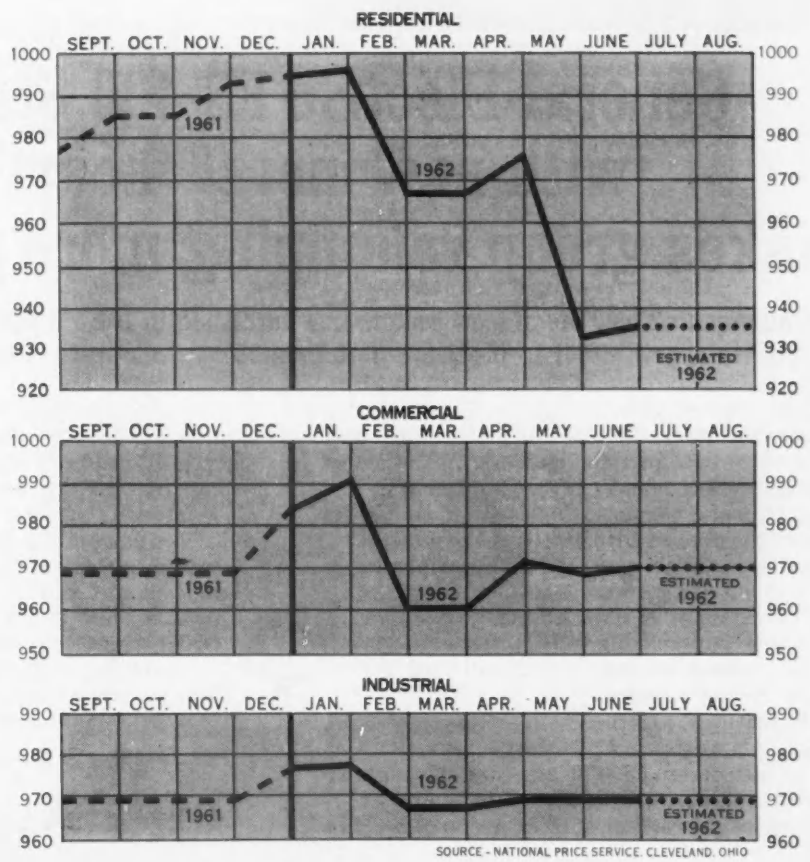
An all-electric home in New Jersey totals nearly 115 kw in connected load. The all-out, no-compromise electrification includes many features in high capacity wiring and equipment of wide interest to residential wiring contractors. Associate Editor J. F. McPartland reports on the installation in "115-KW Load in Residence" beginning on page 86.

ELECTRICAL MATERIALS COST INDEX

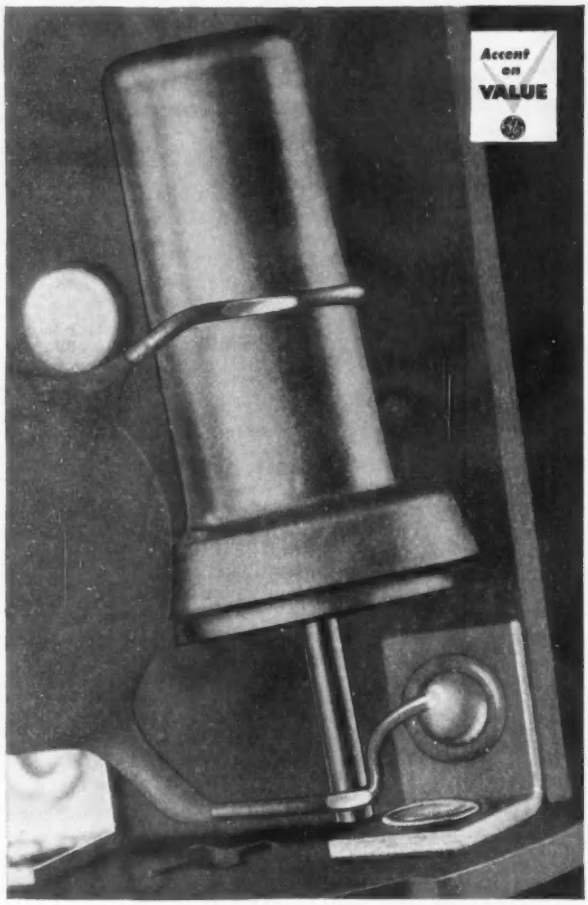
CHANGES IN THE COST OF ELECTRICAL MATERIALS FOR EACH OF THREE TYPICAL JOBS ARE SHOWN ON THESE THREE CHARTS.

THE BASE (1000) REPRESENTS THE AVERAGE COST OF THE MATERIALS FOR THE YEAR 1960

THE MONTHLY INDEX POINTS SHOW THE VARIATIONS IN COST ON THE FIRST OF EACH MONTH.

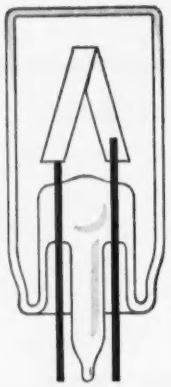


SOURCE - NATIONAL PRICE SERVICE, CLEVELAND, OHIO



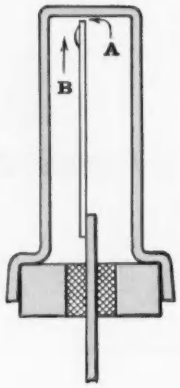
Ordinary Glass Glow Switches

— used in most FS-400 starters have inherent limitations due to the glass envelope. After adjustment has been made in the bimetal gap spacing, the glass must be sealed with intense heat that distorts the bimetal and destroys the accurate gap adjustment... precision cannot be achieved. Glass is fragile, subject to breakage under conditions of vibration or rough handling.



New G-E Metal Glow Switches

— use an accurately drawn steel shell welded to a preassembled base in a cool process where no heat is transmitted to the bimetal. Therefore more sensitive bimetal can be used and accurate gap spacings maintained. Close tolerance in small glow gap permits arc to strike instantly, loading the ballast to eliminate undesirable instant starting tendency.



General Electric FS-400 Starter with new metal "heart" makes group relamping more practical

This outstanding new metal glow switch, now furnished in G-E FS-400 Watch Dog* starters, establishes a new HIGH in precision performance . . . allows full realization of lamp life.

This new type of glow switch employs an accurately-drawn steel shell enclosure, welded to a preassembled base in a cool process. In the manufacturing process, no heat is transmitted to the sensitive bimetal element; thus there is no distortion of the precise adjustment of the bimetal gap spacings. Such control is impossible to achieve in a glass glow switch.

The extra sensitive bimetal, together with a precise side gap spacing (B), predetermines accurate preheat timing... preconditions the lamp for proper starting.

These features, together with the precise, small, top gap (A), resist instant starting six times as much as all other FS-400 starters. Experience shows this increases lamp life. With the new G-E FS-400 metal glow switch starter, group relamping is now more practical than ever. The new General Electric FS-400 also offers these additional advantages over ordinary starters: elimination of annoying blinking lamps; up to 10 times longer starter life; longer life from ballasts.

You can put this latest General Electric innovation to work saving money and maintenance in the fluorescent lighting systems you service, by using new G-E FS-400 Watch Dog starters. Order from your G-E Distributor. For more information, write General Electric Company, Wiring Device Department, Providence 7, R. I.

Registered Trademark of General Electric Company

Progress Is Our Most Important Product

GENERAL ELECTRIC

Washington Report

AUGUST • 1962

The national economy is still advancing, but at a much slower pace. Gross national product in the second quarter was at a total annual rate of $552 billion, up $7 billion from the first quarter annual rate. This was well below the $12.3 billion increase in annual rate achieved during the second quarter of 1961, and far short of the $562 to $567 billion annual rate forecast by President Kennedy and his economists in January of this year.

The Federal government also wound up fiscal 1962 (as of June 30) with a budget deficit of $6.3 billion, which is another way of saying that part of this year's economic growth may be attributed to deficit financing by the government. The 1962 deficit followed a $3.9 billion deficit in fiscal 1961, and the current outlook is for another deficit in fiscal 1963, now getting under way, variously estimated at from $3 to $7 billion.

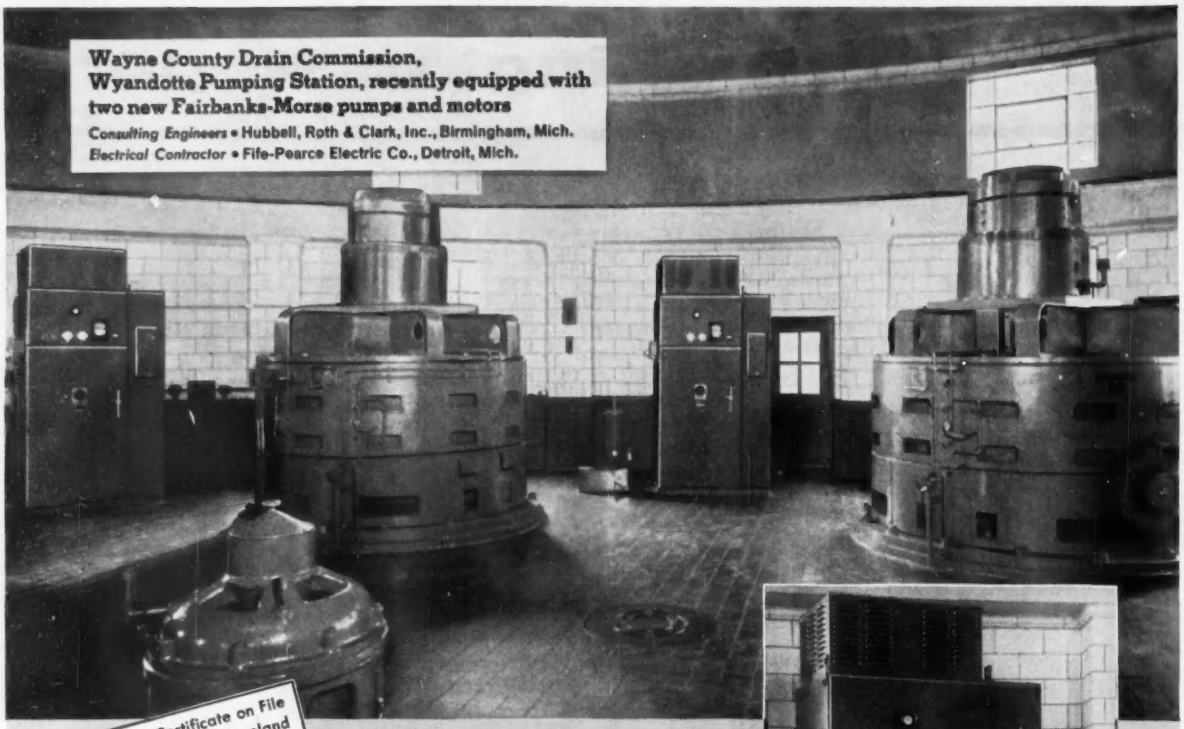
The current slowdown in economic growth is attributed partly to declining steel output, a change in inventory-buying policies by business during the second quarter, and an element of uncertainty as a result of the stock market's behavior during the summer months, and the possible impact of this uncertainty on spending plans by consumers and business.

Several factors contributed to economic growth in the second quarter, including construction spending, consumer spending, and a continuing high rate of Federal, state and local government spending. Also, total personal income was at a new high of $440.4 billion (seasonally adjusted annual rate) in June, employment reached a new record of 69,539,000 in mid-June, and total production was at an all-time record of 117.8% of the 1957 average. Overall, however, the increases were small, some only fractional, giving increasing evidence that consumers as well as businessmen are uneasy about the future.

New construction spending rose to a record for any month in June, when dollar value climbed to a seasonally adjusted annual rate of $63 billion, or 11.4% of the 2nd quarter total economy. This was 4% higher than the May rate, and represented the fourth consecutive monthly increase. Actual spending totaled $5.8 billion, up 10% from the May total, and 10% above outlays in June of last year. Gains were registered in spending for private industrial and commercial buildings, farm structures and utility projects.

Department of Commerce officials also forecast early in July that new construction expenditures are expected to reach a record-breaking total of $60 billion in 1962, or about 6% more than the approximately $57 billion of 1961. Spending for new private housing and highways are expected to gain substantially over 1961, while small declines in outlays for private industrial and public educational structures, compared with 1961, are expected.

Housing starts in June were off 11% from May, for the first month-to-month decline since February. The seasonally adjusted annual rate was 1,389,000 units, while the actual number of farm and nonfarm homes started totaled 132,900 units. This is about the same as for June of last year. In its mid-year forecast for 1962 new construction, Department of Commerce estimated starts would total 1,475,000 units, up 11% from the 1961 level.



Wayne County Drain Commission, Wyandotte Pumping Station, recently equipped with two new Fairbanks-Morse pumps and motors

Consulting Engineers • Hubbell, Roth & Clark, Inc., Birmingham, Mich.
Electrical Contractor • Fife-Pearce Electric Co., Detroit, Mich.

Certificate on File in Cleveland

Certified Fault Protection WITHOUT FUSES!

EC&M Fuseless Starters

ELIMINATE FUSE PROBLEMS & COSTS

Now you can get full fault protection without the problems associated with fuses. EC&M's fuseless starters have certified interrupting capacities of 100,000 KVA at 2400 volts, 150,000 KVA at 4800 volts—an important consideration when starters were selected for the 1250-hp, 4800-volt starters at Wyandotte Pumping Station. This inherent fault protection is an EC&M "exclusive"—and is available with no first-cost premium.

EC&M starters are safe and easy to maintain. A three-way door interlock gives positive personnel protection, and an interlock is provided between the contactor and disconnect switch. Disconnect blades are visible in the open position when the door is open. No roll-out or draw-out needed for maintenance. All six contacts can be replaced without special tools in 10 minutes or so.

These cost-saving features make EC&M starters the logical choice for 2200-4800 volt motor drives.

TYPICAL SAVINGS WITH EC&M STARTERS

	Fused Starter	EC&M Fuseless Starter
Cost of 1250-hp 4800-volt Starter	$xxx.xx	Same as Fused Starter
Spare Fuse Costs: Set of 3 Spare Fuses for 1250 hp	$470.00	0

***SAVE** per starter, up to $500*
(more on larger motors)
...with EC&M Fuseless Starters

Write FOR DETAILS • *Ask for Bulletin 8130*
Square D Company, EC&M Division, 4500 Lee Road, Cleveland 28, Ohio

SQUARE D COMPANY
EC&M DIVISION • CLEVELAND 28, OHIO
wherever electricity is distributed and controlled

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USES UNLIMITED!

ONLY ROCKER-GLO WITH SO MANY STYLES OFFERS THE UNUSUAL TOUCH FOR EVERY KIND OF BUILDING

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PASS & SEYMOUR INC.

SYRACUSE 9, N. Y.

BOSTON CHICAGO LOS ANGELES SAN FRANCISCO


A-C
ALLIS-CHALMERS
first
switch-
gear
with
static
tripping
RESET
TRIP FREE
RACK-IN
CLOSE ONLY
WITH
HANDLE RESET
TRIP

up to now you couldn't get this much distribution protection

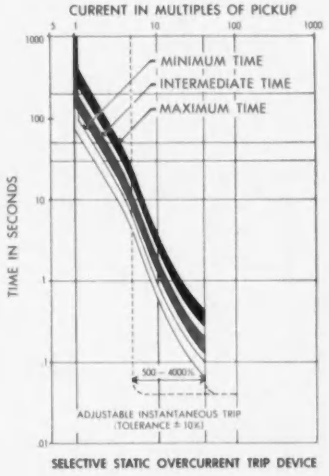
What happens when a fresh, creative approach is applied to the design of 600-volt, metal-enclosed switchgear?

Many improvements result . . . among them, the first application of static overcurrent tripping to switchgear. Means more accurate current sensing, faster response, greater reliability . . . all at no extra cost.

Now you have continuous adjustment throughout the complete current range of each element. Choose either of two static overcurrent trip devices. Dual static trip device combines the long-time element and the instantaneous element. Or the versatile selective static trip device where a higher degree of coordination (delayed fault tripping) is required.

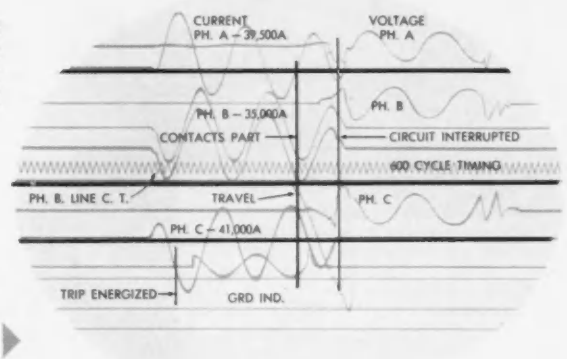
More A-C improvements: track-resistant, flame-retardant *Pyro-Shield* insulation is used throughout, coordinated to assure liberal creepage allowances. Breaker compartment located current transformers provide desirable front accessibility.

The new A-C 600-volt switchgear line is available in continuous current ratings through 4000 amperes and interrupting ratings through 150,000 amperes. *For more information, contact your nearby A-C representative or write Allis-Chalmers, Box 512, Milwaukee 1, Wisconsin.*

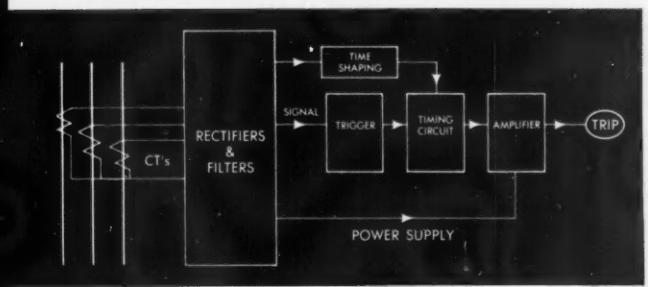


SELECTIVE STATIC OVERCURRENT TRIP DEVICE

More functional time current characteristics and reduced band widths permit better integration into the overall protective scheme.



Typical test oscillogram shows the outstanding performance of LA-600, 25,000-amp interrupting capacity breakers.

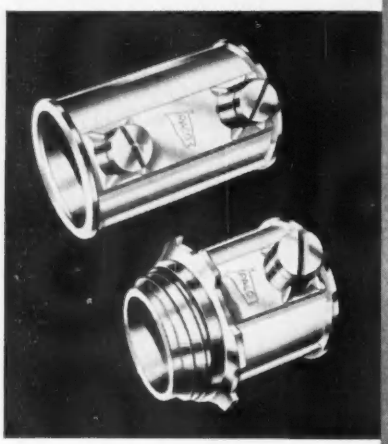


Simplified block diagram of low energy static overcurrent trip system.

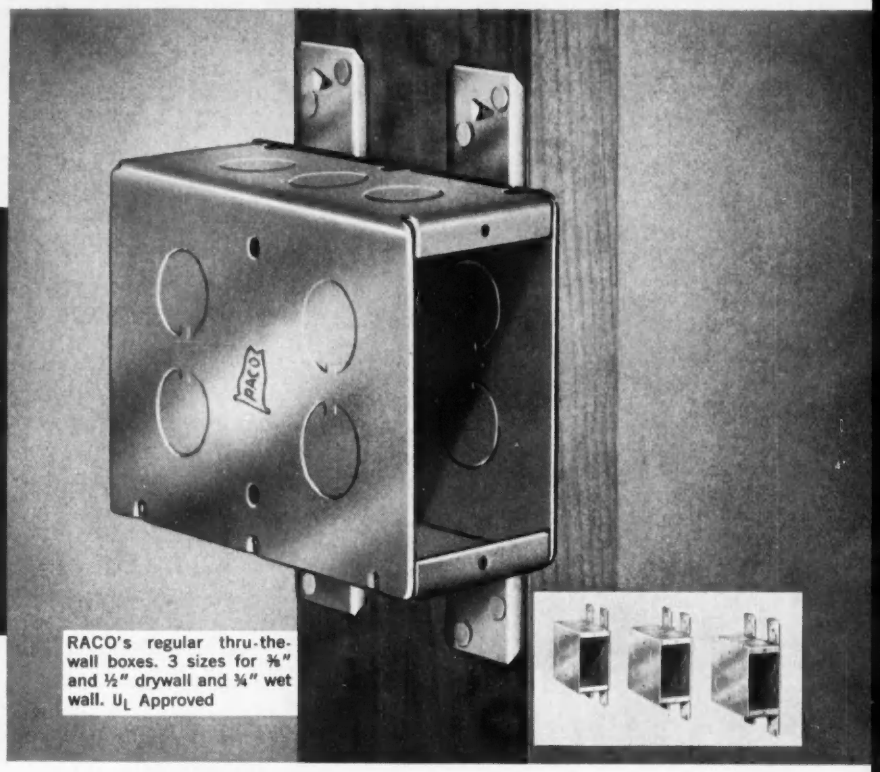
ALLIS-CHALMERS

Pyro-Shield is an Allis-Chalmers trademark. A-1664

NEW FROM RACO

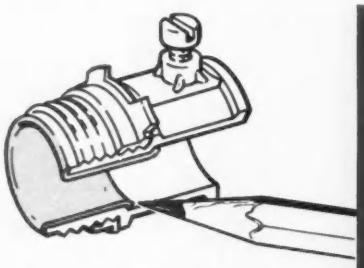


RACO E.M.T. Pressure Cast Set Screw Fittings with Staked Screws. These rugged new fittings have staked screws that are flush with the inside. You never have to back off screws and the screws never fall out. Designed of top quality alloy. Concrete tight. Deep cut threads speed up installation. Connector and coupling available in five sizes ½" to 2".
U_L Approved

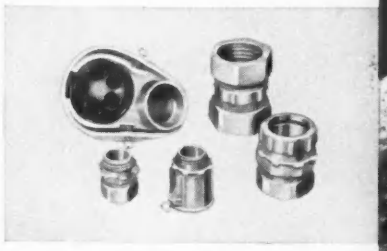


RACO's regular thru-the-wall boxes. 3 sizes for ⅜" and ½" drywall and ¾" wet wall. U_L Approved

Cut Costs with

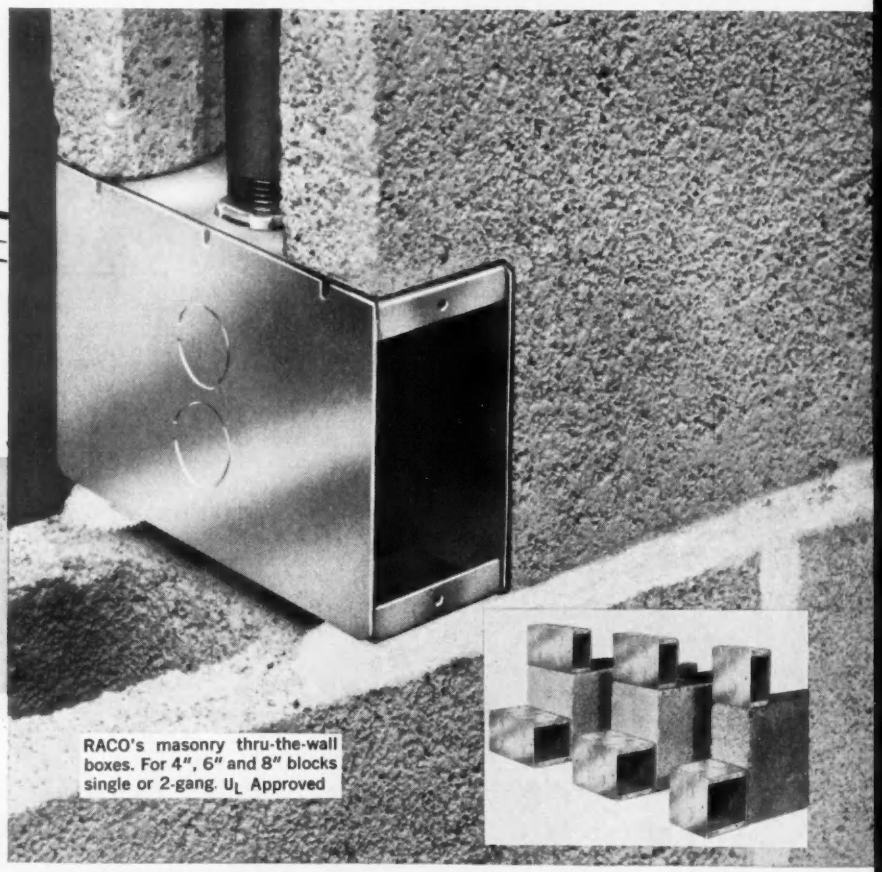


E.M.T. Insulated Throat Set Screw Connector. Cutaway above shows how RACO has rolled the insulated throat over the shoulder. This feature prevents throat from falling out, even with temperature changes. Eliminates the need for a separate plastic bushing. Available in six sizes ½" to 2".
U_L Approved



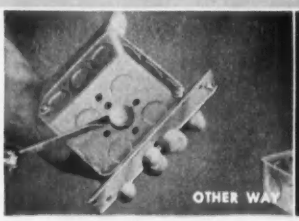
FITTINGS For Every Need

- Rigid Conduit
- E.M.T. (Thinwall Conduit)
- Armored bushed cable, flexible metallic tubing and non-metallic cable
- Service entrances



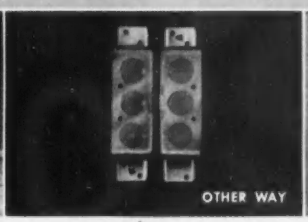
RACO's masonry thru-the-wall boxes. For 4", 6" and 8" blocks single or 2-gang. U_L Approved

REGULAR CONSTRUCTION **SAVE 50%**



Above: Remove KO's on both 4" square boxes.

Below: Nothing to remove thus saving you installation time.



Above: Nipple two 4" boxes together, screw locknut on nipple and tighten.

Below: No nippling and no locknut required. RACO saves you material and time.

Above: Nail two 4" boxes to studding.

Below: One RACO thru-the-wall box, with mounting bracket can be nailed to the stud quickly and easily.

Above: Two 4" square covers put in place.

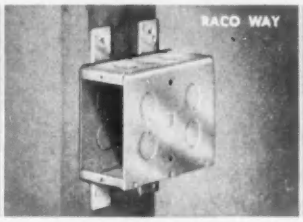
Below: No covers needed, thus . . . eliminating a costly operation.

RACO WAY

OPERATION ELIMINATED

RACO WAY

OPERATION ELIMINATED



RACO WAY

OPERATION ELIMINATED

RACO Thru-the-Wall Boxes

MASONRY CONSTRUCTION **SAVE 38%**

Above: An oversized irregular area must be cut in the block for two 4" boxes.

Below: Fitting square cornered RACO boxes require less work.

Above: Remove KO's from two 4" boxes.

Below: Nothing to remove saving you time on-the-job.

Above: Nipple two 4" boxes together, screw locknut on nipple and tighten.

Below: No nippling required eliminating costly labor and material.

Above: Two plaster covers installed on boxes.

Below: No covers needed on RACO thru-the-wall boxes.

Above: Mudding around is a messy, time consuming job. Holes have to be retapped.

Below: RACO boxes give you a neater, faster job. Device holes are inside . . . no retapping.

RACO WAY

OPERATION ELIMINATED

RACO WAY

OPERATION ELIMINATED

RACO WAY

OPERATION ELIMINATED

RACO®

ALL-STEEL EQUIPMENT INC. Aurora, Illinois

bridle your horsepower with BRONCO CONTROL CABLE

One man operates U. S. Borax & Chemical Corporation conveyor at Boron, California.

FOR THE **DEPENDABILITY** REQUIRED BY AUTOMATED INDUSTRY

...a multi-conductor cable for every type of installation— mobile or stationary, in ducts, conduits, trays, troughs, direct burial, aerial suspension, high temperature...

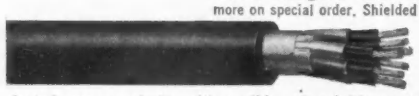
Virtually all of your control cable requirements can now be met by Bronco. Data given here indicates range of sizes shown in the new Bronco Control Cable Catalog, the sizes usually found in the very extensive stock carried in the Bronco network of Servicenters. The extraordinarily complete and versatile facilities for the manufacture of multi-conductor cables established by Bronco can handle your most unusual requests—mixed sizes, short and long lengths, combination power and control cables, shielded sub-assemblies...What's the maximum number of conductors? Ask. Give us the a.w.g. size, we'll reply by return wire.

NEOPRENE

BRONCO Certified 66 NEOPRENE

TYPE SO PORTABLE UL approved

Extra flexible, fine-stranded conductors insulated with color-coded SBR rubber with an outer protecting jacket certified to contain not less than 67.32% neoprene. Branded jackets with all identifying information molded in so it won't rub off. Sizes 18 through 10 with from 5 to 60 conductors, more on special order. Shielded type also available.



STATION

Coated copper conductors either solid, coarse, or medium-fine stranded with a color-coded neoprene coating over each, a branded heavy neoprene outer protecting jacket. Sizes 14, 12, 10, 9, up to 37 conductors.

ASBESTOS

TYPE AVA

For temperatures up to 110°C (230°F) Bronco makes AVA control cable with coarse- and fine-stranded conductors insulated with asbestos and varnished cambric, color-coded cotton braid, covered over all with a closely-woven, impregnated asbestos braid. Sizes 12 and 9, 1 to 19 conductors.

NEW BRONCO CONTROL CABLE CATALOG is now off the press, write for your free copy.

PLASTIC

BRONC-hide stabilized with lead Pb

GENERAL PURPOSE FLEXIBLE THERMOPLASTIC

PVC (polyvinyl chloride) insulation and PVC jacket, flexible-stranded copper conductors, brightly color-coded, 600 volts, sizes 18 through 10 with up to 40 conductors.

I.M.S.A.

Bronc-hide 600 volt Municipal Signal Control Cable has solid copper conductors, is made in four types: with either polyethylene or PVC insulation, with a PVC jacket of either normal thickness, or extra-heavy for direct burial. Sizes 14 and 12 with 3 to 12 conductors.

PNB

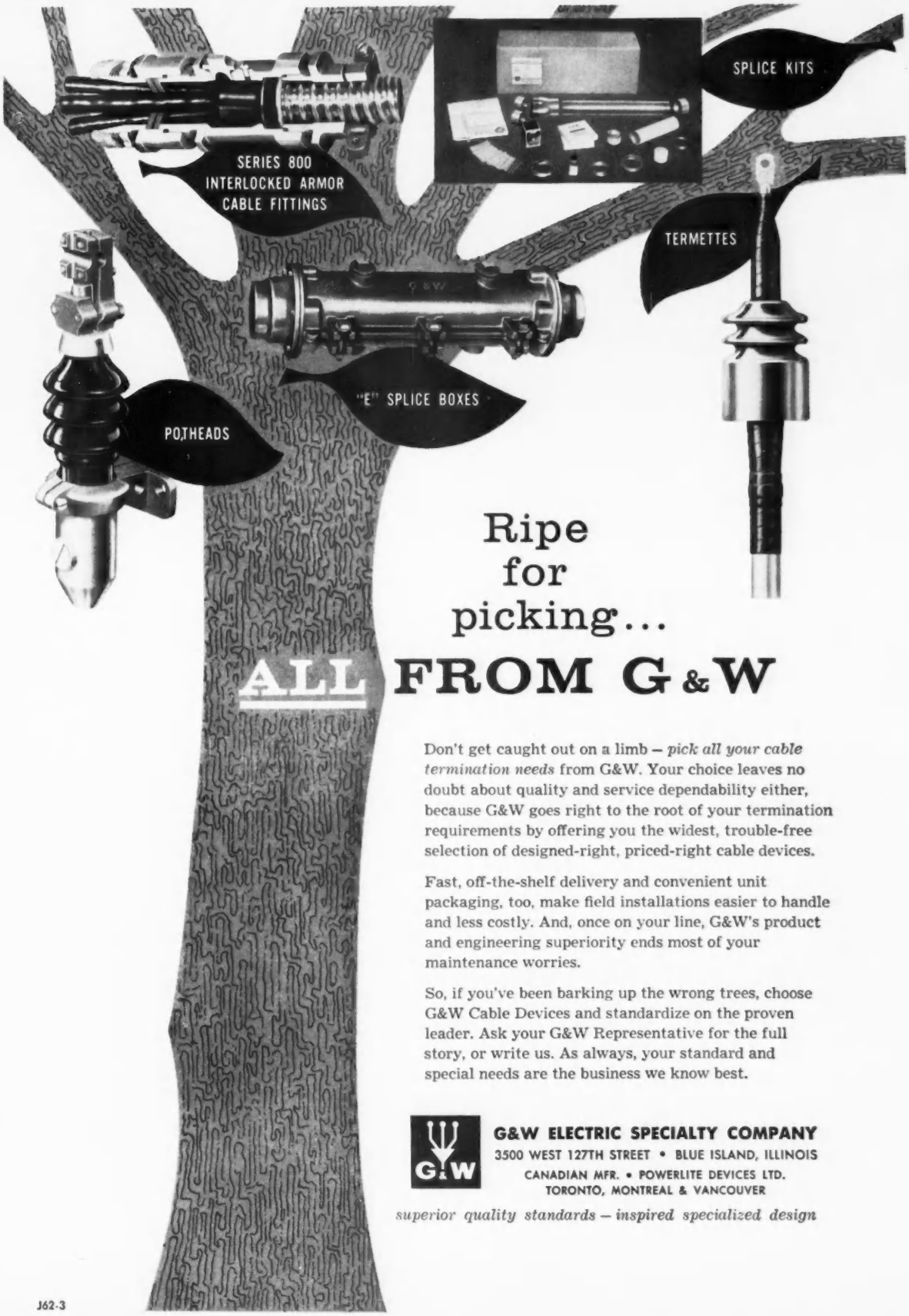
Bronc-hide PNB is a small diameter cable for operating temperatures from —40°F to +167°F. Flexible-stranded, coated copper conductors have polyethylene insulation covered with nylon, a PVC jacket over all. Stock sizes are 14, 12, and 9 with from 1 to 19 conductors.

BRONC-hide Thermoplastic Station Control Cables with 19-strand flexible conductors are made in a complete range of sizes in two types—1000 volt with polyethylene insulation and PVC jacket; 600 volt with PVC insulation and PVC jacket. Bronc-hide 300 volt telemetering cable with paired, solid, bare copper conductors are made in sizes 22, 19, and 16 with up to 50 pairs.

25th ANNIVERSARY 1962

WESTERN INSULATED WIRE COMPANY / LOS ANGELES 58, CALIFORNIA

A QUARTER CENTURY OF SERVICE TO INDUSTRY SELLING NATIONALLY THROUGH ELECTRICAL WHOLESALE DISTRIBUTORS.



Ripe for picking...

ALL FROM G&W

Don't get caught out on a limb – *pick all your cable termination needs* from G&W. Your choice leaves no doubt about quality and service dependability either, because G&W goes right to the root of your termination requirements by offering you the widest, trouble-free selection of designed-right, priced-right cable devices.

Fast, off-the-shelf delivery and convenient unit packaging, too, make field installations easier to handle and less costly. And, once on your line, G&W's product and engineering superiority ends most of your maintenance worries.

So, if you've been barking up the wrong trees, choose G&W Cable Devices and standardize on the proven leader. Ask your G&W Representative for the full story, or write us. As always, your standard and special needs are the business we know best.

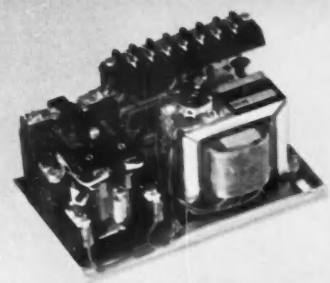
G&W ELECTRIC SPECIALTY COMPANY
3500 WEST 127TH STREET • BLUE ISLAND, ILLINOIS
CANADIAN MFR. • POWERLITE DEVICES LTD.
TORONTO, MONTREAL & VANCOUVER

superior quality standards – inspired specialized design

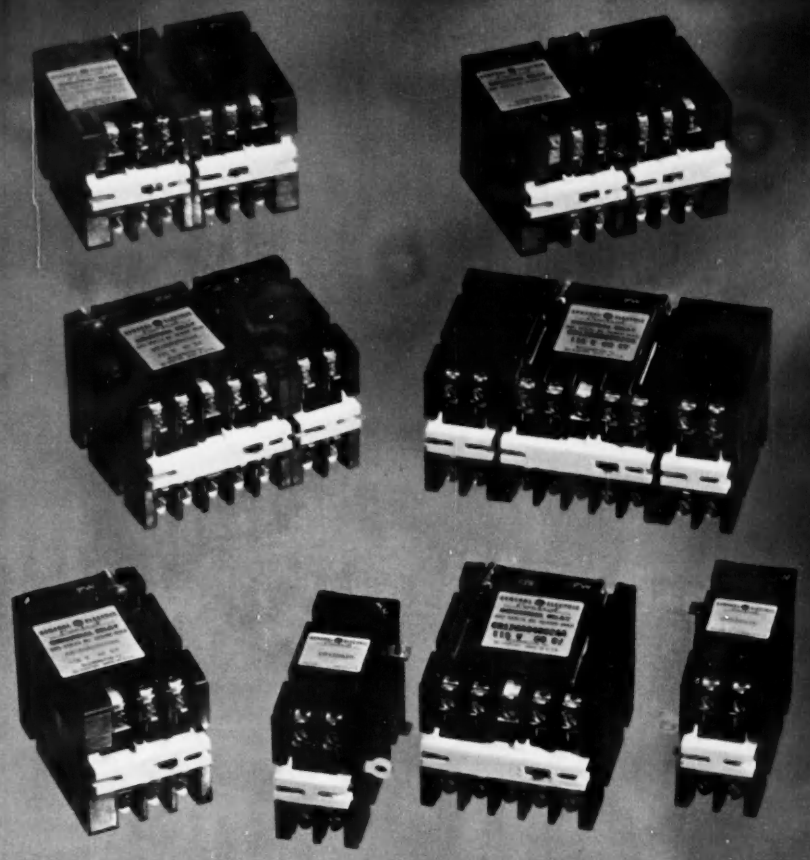
J62-3

Leader in...
CONTROL INNOVATION

A HIGH-QUALITY RELAY FOR *EVERY* INDUSTRIAL APPLICATION

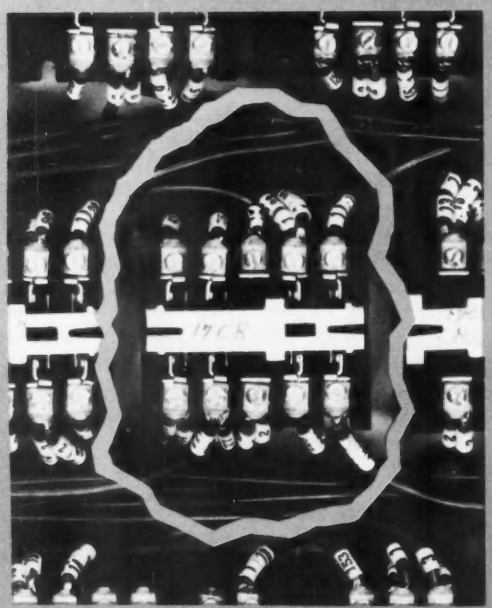


TRANSISTORIZED SENSITIVE RELAY



300-VOLT RELAYS

G-E 300-volt Relays Are Easy to Inspect



General Electric's new 10-ampere, 300-volt relay has many inspection and maintenance features that no other relay offers:

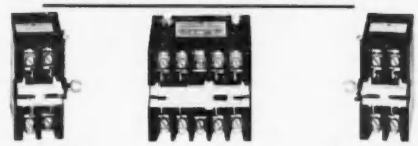
- All contacts visible from front without removing wiring or disassembling the device—this gives quick indication of contact position, provides safety check during testing and trouble shooting, saves wiring time during changeover.
- Manual operation of contacts and ON-OFF indication of coil operation on standard form makes inspection and check out easy.
- All terminals out-in-front, easy to get at to speed wiring—even on 8-pole forms.
- Write-on surface—makes relay and terminal identification fast, easy . . . speeds circuit check out.
- Terminal clamps ride up with wire, facilitate wiring if circuit must be changed after installation.
- Contacts are convertible—takes only 90 seconds; coil can be removed and replaced in 30 seconds . . . permits greater flexibility, saves maintenance costs.

This relay offers dependable, long-life performance on your equipment. Unique self-cleaning contact action forces aside contaminants, assures high contact fidelity; high-tip pressure and fine-silver, double-break contacts provide positive "make."

and Maintain, Reduce Inventory Costs

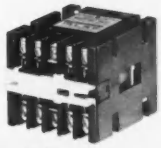
CUT INVENTORY COSTS

Stock Just Three Forms . . .



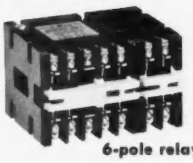
2-pole adder 4-pole relay 2-pole adder

And Get This . . .



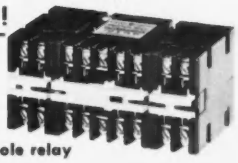
4-pole relay

Or This . . .



6-pole relay

Or This!



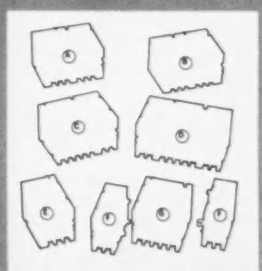
8-pole relay

PNEUMATIC TIMERS AND LATCHED RELAYS AVAILABLE

Pneumatic timers and latched relays complete the line of 300-volt devices—**all** forms are available for stock shipment. Relays are also offered with fixed-tip contacts, overlapping contacts, coil clearing contacts, and d-c coils.

FORMS ILLUSTRATED IN COLOR PHOTO ABOVE:

A—4-pole latched relay
B—Pneumatic time-delay relay
C—6-pole relay
D—8-pole relay
E—2-pole relay
F—2-pole adder
G—4-pole relay

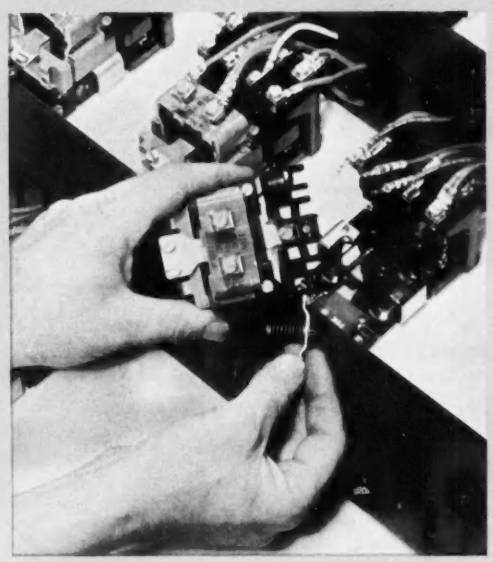


Turn Page For Information On Other G-E Relays

G-E 600-volt Relays Provide Maximum

Here's how the flexibility of General Electric 600-volt relays help you cut costs:

- You can choose from a **complete line** of relays, including 12-pole forms. Other forms available are 2-, 4-, 6-, and 8-pole relays. Latched forms are offered in the same number of poles and contact arrangements as standard relays.
- You get maximum circuit flexibility—G-E 10-ampere, 600-volt relays, are available with any combination of normally open and normally closed contacts.
- You can convert contacts from normally open to normally closed (or vice versa) from in front of the relay . . . it takes only a minute. Fixed-tip forms are also available.
- You can change coils from the front without removing the relay from the panel. Just loosen three screws, remove and install new coil.
- Relay functions are easy to add to original circuit using the same mounting holes. Two-, four- and six-pole in-line relays have common mounting dimensions; so do 8- and 12-pole forms. Three-point keyhole and slot mounting on all forms simplifies and speeds installation.
- All terminals are out-in-front, easy to reach. Captive, saddle clamps ride up with large, panhead screws to further facilitate wiring.



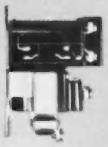
G-E 600-volt relay contacts are convertible . . . can be changed without removing relay from the panel.

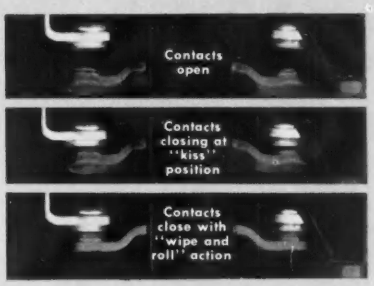
Circuit Flexibility, Dependable Operation

20,000,000 OPERATIONS WITHOUT FAILURE . . . THAT'S RELIABILITY!

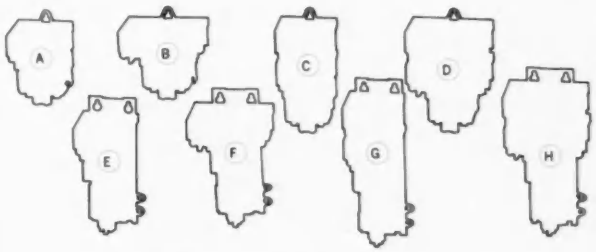
Greater contact fidelity is possible in G-E relays because of smooth "wipe and roll" closing action of the contacts. This keeps the contacts clean and assures contact closure (fidelity)—even after millions of continuous operations.

For example, a leading automotive body stamping company conducted a series of tests—including an accelerated life test—to find the most reliable 600-volt relay. **The General Electric relay was still "making and breaking" twenty million operations later**—long after all competitive relays had failed.





FORMS ILLUSTRATED IN COLOR PHOTO ABOVE



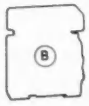
A—4-pole 600-volt relay
B—6-pole 600-volt relay
C—8-pole 600-volt relay
D—12-pole 600-volt relay
E—4-pole latched relay
F—6-pole latched relay
G—8-pole latched relay
H—12-pole latched relay

Turn Page For Information On Other G-E Relays

Compact G-E General-purpose Relays

FORMS ILLUSTRATED IN COLOR PHOTO ABOVE

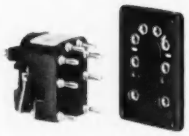
A—CR2790 Type E



B—CR120 Type E

C—CR120 Type J

OTHER GENERAL-PURPOSE FORMS AVAILABLE



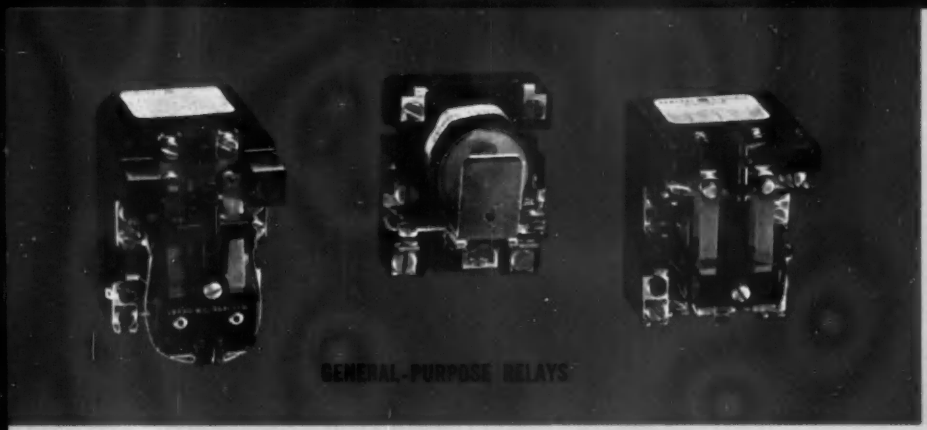
CR2790 for plug-in applications

CR120E resistor-type relay

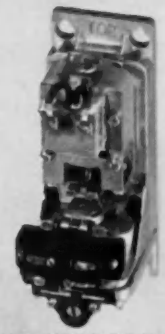
CR120E transformer-type relay

CR120J 2-pole relay

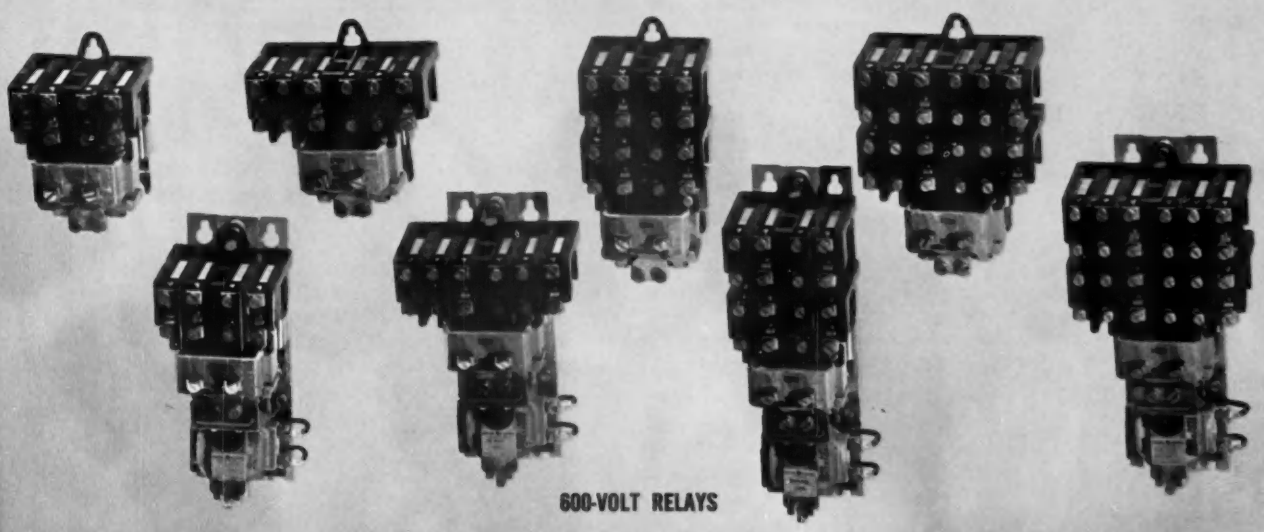
CR120J 4-pole relay



GENERAL-PURPOSE RELAYS



PNEUMATIC TIME-DELAY RELAY



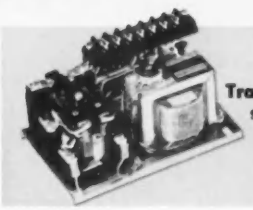
600-VOLT RELAYS

G-E Relays for Special Applications

Pneumatic time-delay relay

G.E.'s CR2820 B—Series A pneumatic time-delay relay is adjustable from 1/5 to 180 seconds with a repetitive accuracy of ±10 percent of the average time setting. The relay is available with up to 2NO–2NC time-delay contacts and 2NO–2NC instantaneous auxiliary contacts to control a maximum of eight circuits. All a-c forms have the same mounting dimensions.

Relay can be changed from time delay on energization to time delay on de-energization in the field. Time-delay or instantaneous auxiliary contacts can be added in the field. A special form with dial allows previous settings to be duplicated.



Transistorized sensitive relay

General Electric's new transistorized sensitive relay—CR120F—is designed for making and breaking 10-ampere, 300-volt circuits upon receiving signals from low-current carrying devices or for sensing the presence or absence of a high or low resistance circuit. The relay offers long life; requires no "warm-up" period; provides fail-safe operation.

You get **MEASURABLE VALUES**
with GENERAL ELECTRIC CONTROL

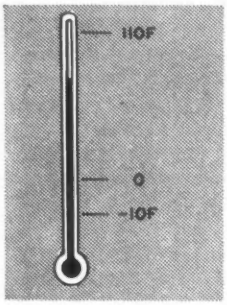
For complete information on General Electric relays, contact your nearest G-E Distributor for publication GEA-7345, or write Section 813-41, General Electric Company, Schenectady 5, New York.

Progress Is Our Most Important Product

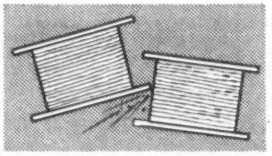
GENERAL ELECTRIC

CABLE TALK

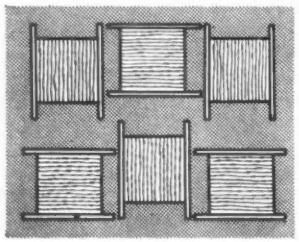
6 tips to help you save money on cable installations

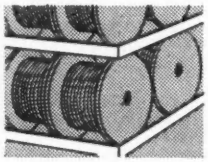


1. Avoid extreme temperatures –below 10F and above 110F (unless cable is specifically designed for this purpose). Low temperatures are seldom harmful to cable, but when they are combined with impact, flexing or other mechanical action, it's possible that the cable may be damaged by cracking, flaking or complete rupture of the coverings. Excessively high temperature, all by itself, can materially shorten the potential service life of stored cable. Thermoplastic components may soften and flow; rubber and many other materials undergo chemical and physical changes at high temperatures. You can avoid this problem by not storing cable near heating units, steam pipes, etc.

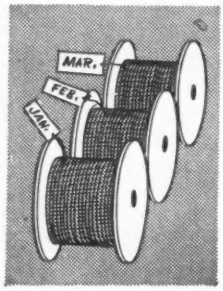


2. Avoid mechanical impact and crushing. Wire on a reel can be rendered useless by allowing the flange of another reel to crash against it. Arranging the stored reels in a crosshatch pattern is the simplest way to avoid this kind of accident. If space is at a premium, the reels may be stored in trays that allow only the flanges of adjacent reels to contact.

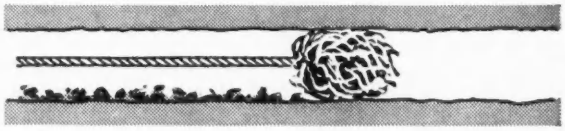




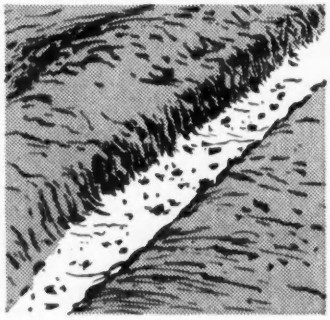
3. Use the oldest stocks first. Very few materials improve with age, so the sooner you use stored cable the longer it will last in service. Also, the less time a cable spends in storage, the less chance there is for damage. Keep rotating stocks so that the newest cable goes to the end of the line.



4. Swab conduit before pulling wire
A remarkable amount of abrasive material–nails, glass and such–can accumulate in conduit, pipe or duct before the wire is pulled through. And pulling a wire or cable through such litter could damage it severely. If you pull a swab through the conduit ahead of the wire to clear the way, you'll eliminate a big source of hidden installation damage.



5. "Direct burial" doesn't mean "on top of anything"
The specification "direct burial" on a cable doesn't mean that you can afford to bury the cable directly on top of whatever you might find in the earth. Trenches should be cleared of rocks and broken glass before the cable is buried. Freezing and thawing can make rocks shift position, and, possibly, exert enough pressure on the cable to cause premature failure. The same danger exists when wires that cross underground rest on each other. Moral: clear trenches before burying cable, bed the cable in sand, and keep crossed cables separated.



6. Pick the strongest component when pulling cable
When wire or cable is being pulled-in, either through conduit or aerially on poles, it's essential to put all the pulling tension on the strongest part of the cable assembly. Ordinary single-conductor material should have pulling tension applied to the bare conductor. Applying tension to the covering materials tends to stretch them, and can lead to breaks in some cases. Always pull preassembled aerial cables by the messenger, not by the insulated conductors. Interlocked-armor cable should never be pulled by the armor, since this may cause severe damage by unlocking the armor.

* * *

This collection of ideas comes from many years of probing into wire and cable problems–and solving them. It's likely that we've come across some problems just like yours, and together we could probably work out a fine solution. So, please give us a call, or write Anaconda Wire and Cable Company, 25 Broadway, New York 4, New York. Department EFL-1-ECM. 61304

"Hard Hats" Prefer T&B Distributors . . .

because they're a local source for over 60,000 Code approved products. T&B products cut installation costs. T&B distributors reduce your operating costs.

Here is an example of a product line that can put dollars into your pocket. All of the products below are listed by Underwriters' Laboratories, Inc., and meet or surpass the requirements of T&B Laboratories and the National Electrical Code, paragraph 373-6 (b). The bright blue nylon liner is a T&B exclusive . . . insulates and protects wire **during** and **after** installation. A flawlessly smooth surface measurably reduces wire pulling effort. The insulated throat is unaffected by moisture, high operating temperatures and common corrosive atmospheres. The result is lowest installed cost and no callbacks.

INSULATED THROAT FITTINGS FOR LIQUID TIGHT FLEXIBLE CONDUIT

1. Liquid Tight for Threaded Outlets
2. Chase® Liquid Tight for JIC Boxes

INSULATED THROAT FITTINGS FOR STANDARD RIGID CONDUIT

1. Threadless Connectors
2. Chase® Nipples
3. Insulated Threadless Elbow

BLUE BUSHINGS FOR RIGID CONDUIT

1. Unbreakable Plastic Bushing
2. Insulated Grounding Bushing
3. Insulated Metallic Bushing

INSULATED THROAT FITTINGS FOR E.M.T. AND FLEXIBLE CONDUIT

1. E.M.T. Raintight Connector
2. E.M.T. Raintight Short Elbow
3. Straight Tite-Bite® for "Flex"

SOLD COAST-TO-COAST THROUGH AUTHORIZED T&B DISTRIBUTORS

T&B ENGINEERED **THOMAS & BETTS**

The Thomas & Betts Co., Incorporated • Elizabeth, New Jersey
In Canada, Thomas & Betts Ltd. • Montreal

Insulated throat fittings are Patented.

"Extremely accurate,"
Denver sales manager

"Beautiful styling,"
Seattle accountant

3 out of 4 people prefer

Put this over-all preference to work for you with Honeywell electric heat

In a recent survey of homeowners, three out of four, familiar with controls, preferred Honeywell.

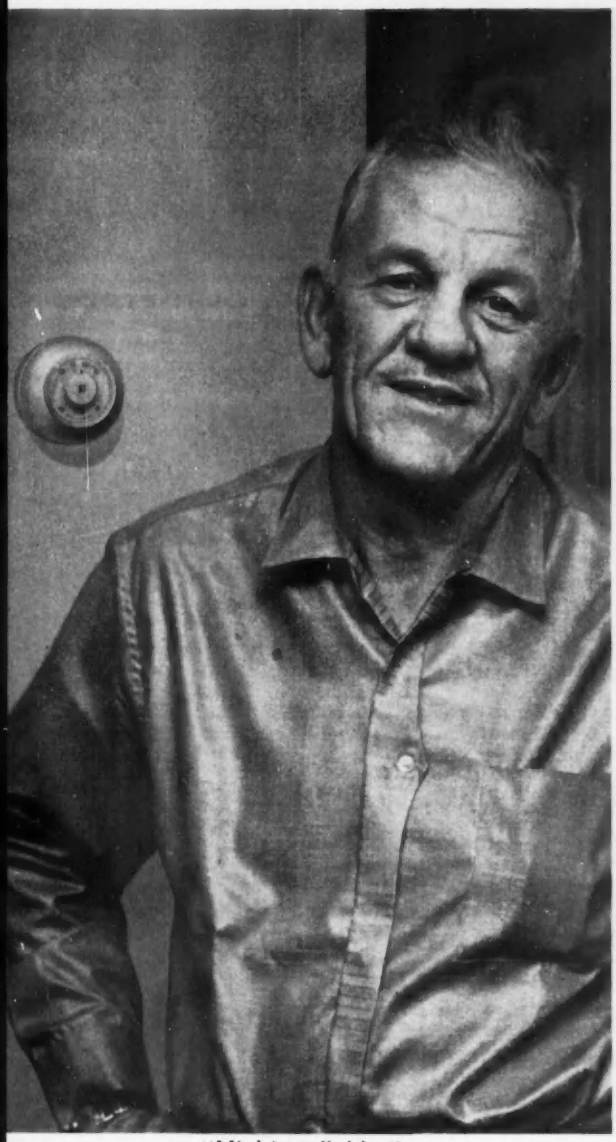
Most of your new customers have lived with Honeywell controls. Shouldn't you put this overwhelming preference to work for you in your installations?

When you combine Honeywell with your own fine brands of electric heating equipment, you've got a combination that can mean more customer satisfaction, easier sales, more profits. Let Honeywell's new electric heat thermostats and new linear limit control join your sales team. They can be a big help.

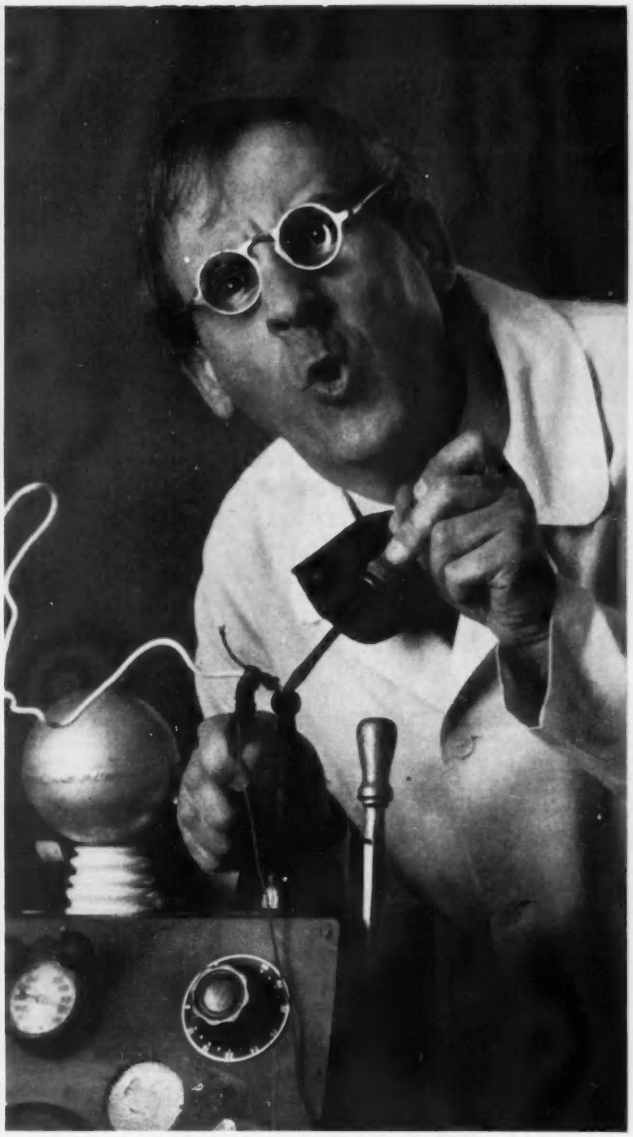
Low-Voltage Controls let you offer variety

With the Honeywell R8097 Relay, which allows you to use Honeywell's low-voltage controls, you can offer the widest range of low-voltage thermostat combinations in the industry. All the way from the most economical to the famous Honeywell Round to the deluxe thermostats and Control Centers.

Why don't you ask for detailed information on both low-voltage and line-voltage temperature controls now? Just call the nearest Honeywell sales office or write Honeywell, Dept. EC8-24, Minneapolis 8, Minn.



"Mighty reliable,"
Detroit truck driver



"I'll make my own controls,"
Free-lance scientist

Honeywell Controls

controls, too. They'll help you sell the high quality of your installation.

The new wall-mounted Honeywell T462 Line Voltage Electric Heat Thermostat (and unit mounted T460) give dependable, worry-free performance. The control range is from 40° to 85° with a one-half degree differential.

New, rugged construction makes the units stronger. They are easier to set, rugged and dependable, too. They operate electric heaters up to 5000 watts, responding to both radiant and convected heat. Two switching variations are available in both models. Model T462A and T460C are SPST that make on a temperature fall and provide a line break at NO HEAT. Models T462B and T460D have the added feature of breaking both lines in OFF position.

NEW, EXCLUSIVE ELECTRIC HEAT TRAINING PROGRAM! Sales and service meetings studying a new and thorough working manual: "Fundamentals of Automatic Electric Heating." Call the Honeywell office nearest you about the next session.

Honeywell

H HONEYWELL First in Control

S&C power fuses are going places

The power fuse has come a long way in fifty years—from S&C's liquid fuse to S&C's sophisticated, boric acid fuse of today. Now, with interrupting ratings up to 1,000,000 kva in the Type SM (720 amperes continuous), and 2,000,000 kva in the Type SMD (540 amperes continuous), S&C power fuses are being adapted to virtually every conceivable system protection need. Power fuses are used indoor and outdoor; enclosed and in the open; in plants and buildings; on transmission and distribution lines; on overhead poles; in pad mounted gear; and in underground vaults. These fuses provide predictable protection with simplicity and economy. That's why they are going places.

Places like these:

1. ON WALLS

Now you can hang 500,000 kva on a wall with S&C's line of high-voltage metalclad fuses. These compact units conserve valuable floor space while providing fully adequate high-voltage fault protection on industrial and commercial power circuits.

2. IN VAULTS

Newest addition to S&C's metalclad fuse line is the submersible style for use in vaults or basements where flooding is a possibility. Rated at 4.8 and 14.4 kv, these units carry 200E or 400E amperes continuous, and have interrupting ratings up to 500,000 kva.

3. IN PLANTS AND BUILDINGS

Power fuses, combined with load interrupters and packaged as S&C Metalclad Switchgear, cut protection costs in half by replacing circuit breakers. Power fuses provide needed protection against permanent destructive faults encountered on industrial and commercial high-voltage circuits. (Load interrupters do the switching.)

4. IN SUBSTATIONS

The 1,000,000 kva interrupting rating (at 34.5 kv) of S&C's Type SM Power Fuse has made it first choice for protection of large power transformers in distribution substations. This means low-cost, maintenance-free protection against primary and secondary faults, without main line outages.

5. ON POLES

S&C power fuses can be pole-mounted for line sectionalizing, fusing distribution transformers where short-circuit currents are unusually high, and protecting distribution feeders. Low energy arc-extinguishing action reduces exhaust blast hazards to tolerable limits for linemen and the public alike.

6. IN PAD MOUNTED GEAR

At sectionalizing points or connected to pad mounted transformers, S&C power fuses protect (and even switch) residential underground circuits—in air. The wide choice of fuse ratings enables the utility to uprate its underground system to accommodate future growth needs.

S&C OUR GOLDEN JUBILEE

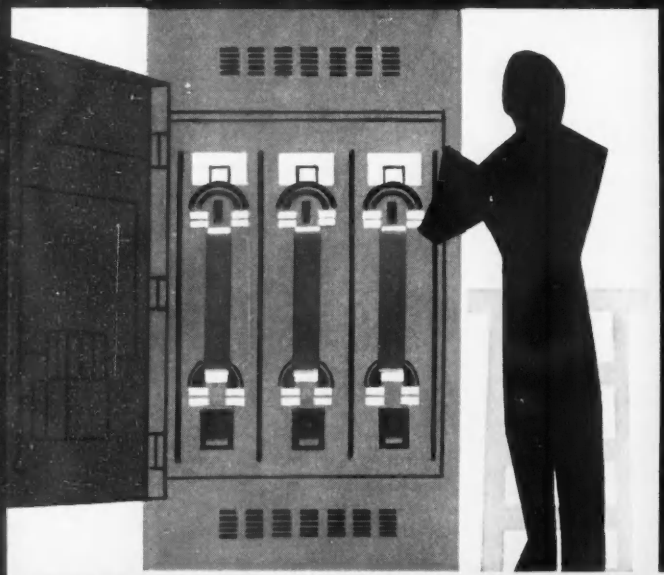
For additional information on S&C power fuses, contact your local S&C representative or write to:

S&C ELECTRIC COMPANY

6605 Ridge Boulevard • Chicago 26, Illinois

Specialists in High Voltage Circuit Interruption since 1911

1



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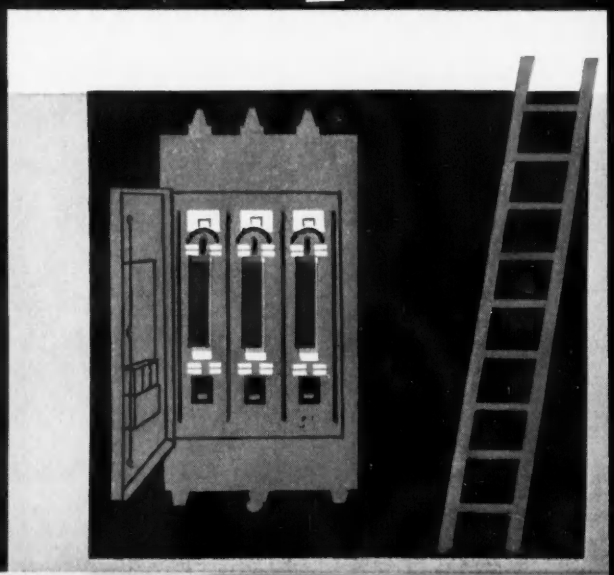

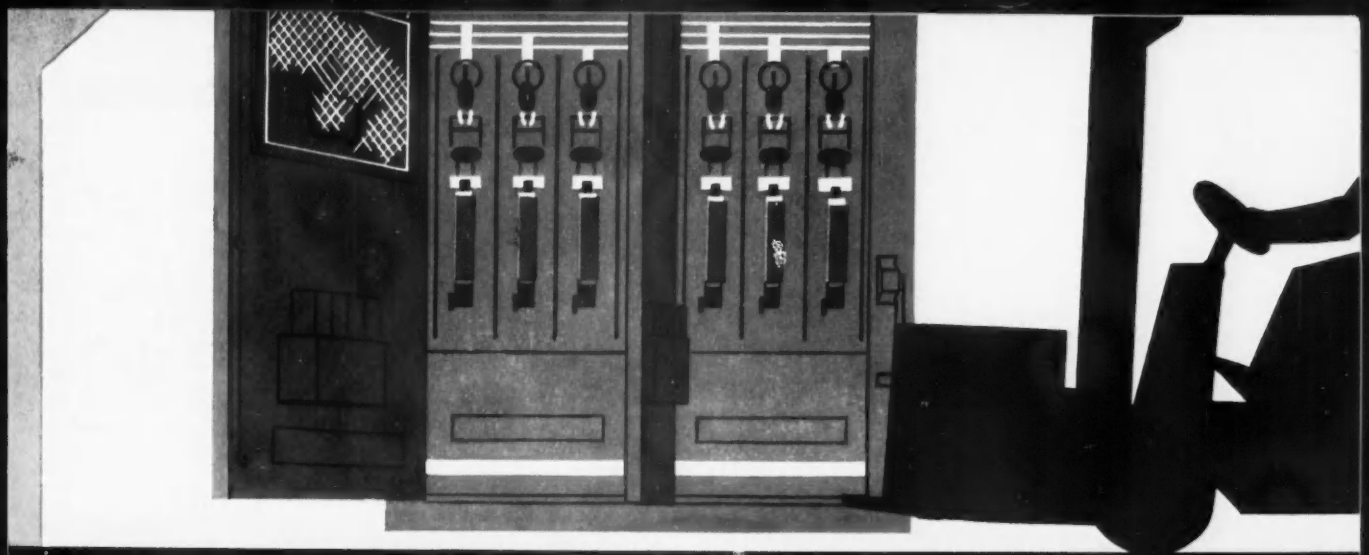

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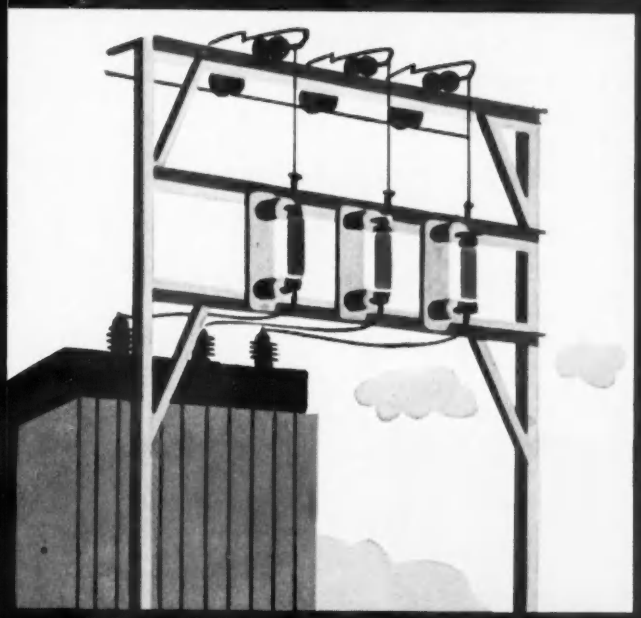

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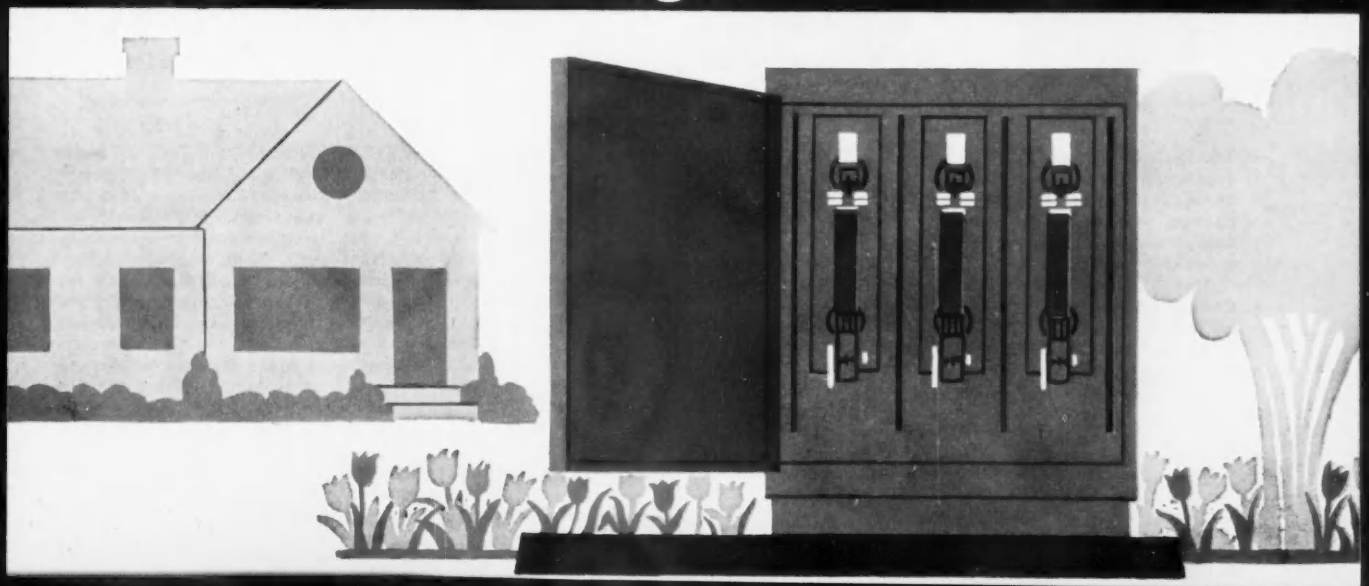
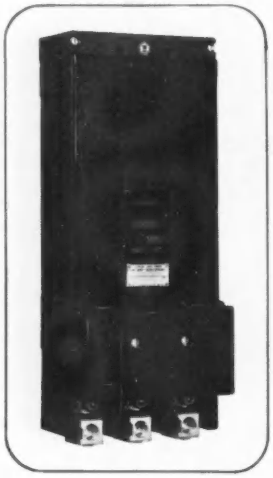


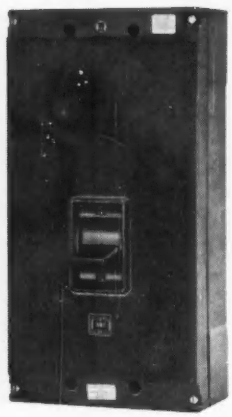
A buyers' guide to optimum circuit protection

100,000 amperes interrupting capacity



TRI-PAC—The Westinghouse Tri-Pac® circuit breaker offers triple circuit protection in one compact unit: an inverse time delay thermal trip, an instantaneous magnetic trip, and current limiting protection. Continuous current rating to 600 amps, two or three poles; interrupting capacity up to 100,000 amps.

High fault protection at low cost



MARK-75—With high interrupting rating, this economical Mark 75 breaker provides complete protection in systems, like networks, where available fault currents may reach 75,000 amperes at 240 volts a-c; 30,000 amperes at 600 volts a-c. Available in current ratings from 70 to 1,000 amps, two or three poles.

Visible contacts for special safety codes

SAF-T-VUE—Saf-T-Vue® breakers permit the operator to see whether the contacts are open or closed. This feature is ideal where safety codes require visible contacts for maintenance men and operators. The transparent window is heat-resistant thermo-plastic that won't scorch or cloud with normal overloads. Available in ratings up to 1,000 amps a-c.

Complete protection for most applications

THERMAL-MAGNETIC—Westinghouse Thermal-Magnetic breakers have become the standard for protection of distribution system 600 volts or less. Available in all frame sizes, this breaker provides instantaneous opening on short circuits. On sustained overloads, the higher the current, the shorter the opening time. Factory tested for unmatched reliability; available in ratings to 1,000 amperes.

If one molded case circuit breaker served every need, that's all Westinghouse would build. But precise protection at lowest cost calls for specialized solutions. That's why Westinghouse builds hundreds of variations to the seven basic types featured here. It's the world's most complete line, based on over 35 years of continuing product research and development. Use this buyers' guide for general applications. For specific circuit protection problems, contact your Westinghouse representative, Westinghouse distributor, nearest independent panelboard/switchboard builder, or write Westinghouse Electric Corporation, Standard Control Division, Beaver, Pennsylvania. *You can be sure . . . if it's Westinghouse.*

Fast, short-circuit protection only

MAGNETIC-ONLY—Designed specifically for short circuit protection, the magnetic-only circuit breaker is used on systems where overload protection is provided by other means. Front adjustment allows five main setting positions and four mid-setting positions. Typical applications are motors, resistance welding and resistance heating. Available to 1,000 amperes, continuous current ratings.

Rugged construction for military use

NAVY-TYPE—The Navy-type breaker has very high mechanical strength, and resistance to fire, moisture and shock. Under shock conditions the trip stays in latch position, but doesn't prevent thermal or magnetic trips from overload or short-circuit. Has plug-in connector, interchangeable trip units and calibration for 50°C. Available in ratings to 600 amps at 500 volts a-c.

Precise calibration for low currents

TYPE-550—The Type-550 is designed specifically for sensitive electronic equipment where fractional ampere ratings and exacting protection are required. Special plating resists moisture and fungus. Interrupting capacities range from 1,000 to 3,000 amps with ratings from .02 to 50 amps, maximum voltages of 250 a-c and 50 d-c.

J-30344

Westinghouse

Now from Simplex . .

CROSS-LINKED

A new insulated power cable that offers you exceptional properties at lower-than-rubber cost, including:

Higher Ampacity (90° maximum conductor operating temperature as compared to 75° for polyethylene)

Small Diameter (Superior characteristics allow approximately 30% reduction of insulation wall as compared with rubber insulation and a corresponding reduction in over-all diameter.)

And exceptional resistance to Chemicals . . . Ozone . . . Abrasion . . . Crushing

Simplex 15KV C-L-P being installed at West Nyack, N.Y. by Orange and Rockland Utilities, Inc. C-L-P's smaller diameter means lighter weight, easier handling.

. . . C-L-P T.M.

POLYETHYLENE with VOLTAGES TO 15 KV

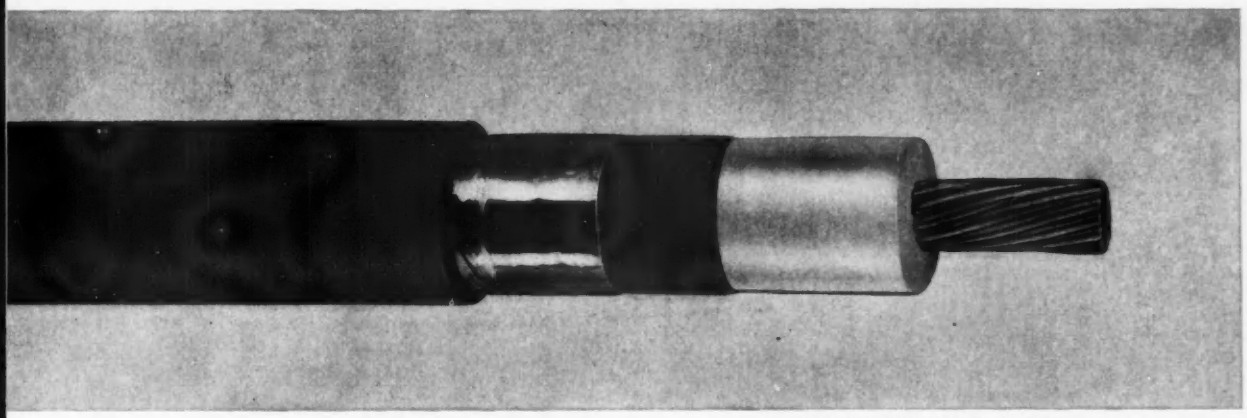


ILLUSTRATION ACTUAL SIZE

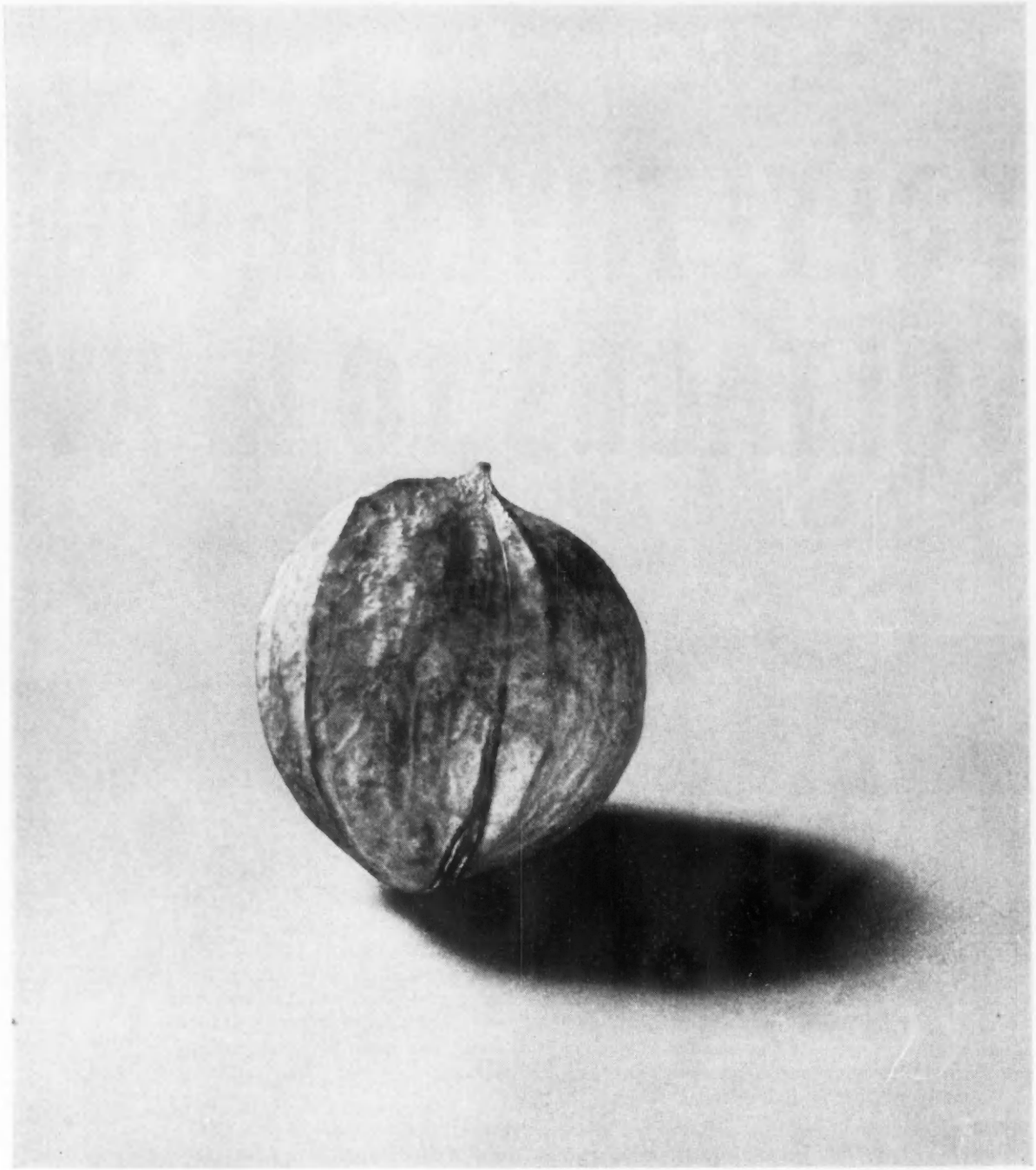
Simplex C-L-P Power Cables feature a newly developed *thermosetting* polyethylene insulation with a cross-linked molecular structure. The cross-linking of the molecules results in an unusually stable polyethylene which — with further Simplex refinement — combines some of the best properties of rubber and polyethylene in one insulation. C-L-P insulated cables are suitable for use in ducts, conduit or trays and for aerial, submarine or direct burial applications under almost any conditions of environment, yet their cost is less than comparable rubber-insulated cables.

Now installed and operating, C-L-P cross-linked polyethylene cables represent one of the most important cable breakthroughs of the past 25 years. Write Simplex today for performance and cost comparison data.

Simplex
WIRE & CABLE CO.

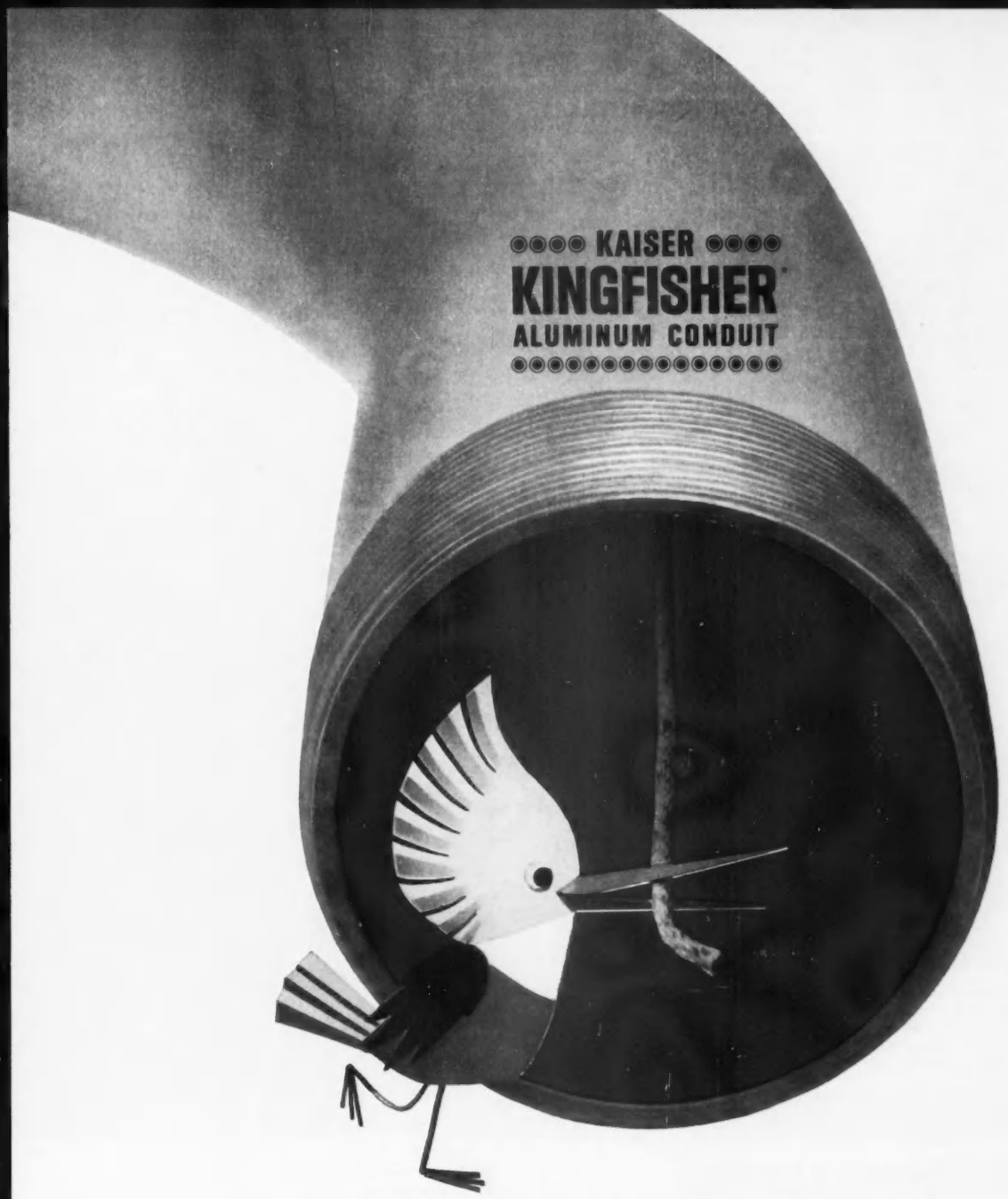
EXECUTIVE OFFICES: Cambridge, Mass.

Plants at Cambridge, Mass., Portsmouth, N. H., Westbury, L. I., Monrovia, Calif.



MEET A TOUGH NUT . . . Just a gimmic to catch your eye? Hardly, it's symbolic because hickory nuts are tough. So are new "Sisal" impregnated NON METALLIC new work boxes by UNION. Now twice as strong, and don't forget the advantages you already know about such as lower initial cost—less installation time—no box grounding—no clamps—exclusive plaster seal—handy knock-outs. So if you've been drooling over the savings Union offers but have hesitated in favor of the old fashioned way—forget it! You deserve as much profit as your competitor. Complete line—boxes and covers, "Weatherbest" lighting fixtures, pigtail and pin type sockets, insulating, grounding and male bushings. UL approved. Contact your distributor now.

UNION INSULATING CO.
PARKERSBURG, WEST VIRGINIA



LOOK FOR THE PURPLE LINING THAT MAKES CABLE PULLS 61% EASIER

In tests† comparing lined and unlined conduits (including steel) the purple silicone lining in Kaiser KINGFISHER let cables slip past the third bend up to 36% easier . . . past the fourth bend up to 61% easier.

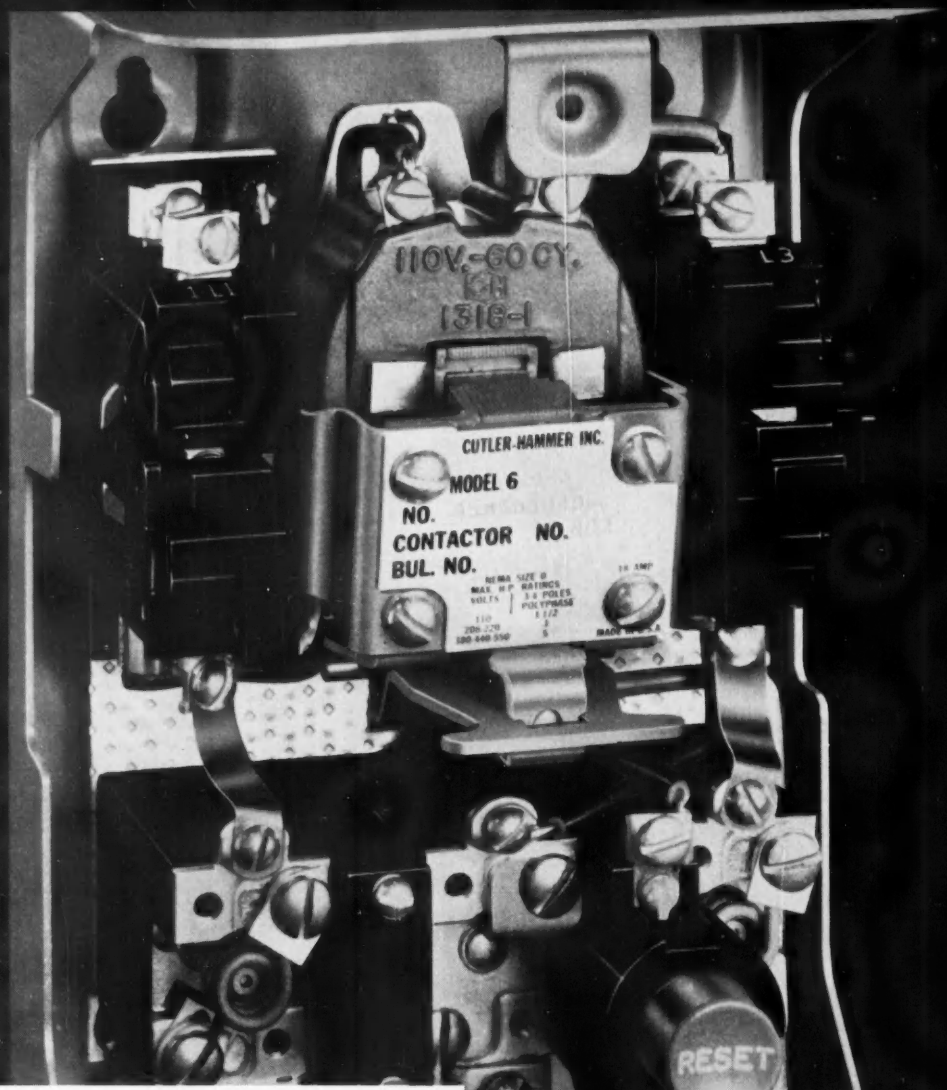
Kaiser KINGFISHER gives you four more time saving differences: light weight, easy cutting, uniform bending, and exclusive high strength forged couplings.

Only competitively priced Kaiser KINGFISHER has all the advantages of aluminum plus slick K-40 silicone lining. Cut installation costs on your jobs: look for the purple lining that makes cable pulls easier . . . from your authorized Kaiser KINGFISHER Distributor.

†Using 3 #2RHW cables in 1¼" conduit.
* Trademark of Kaiser Aluminum & Chemical Corporation.

KAISER ALUMINUM

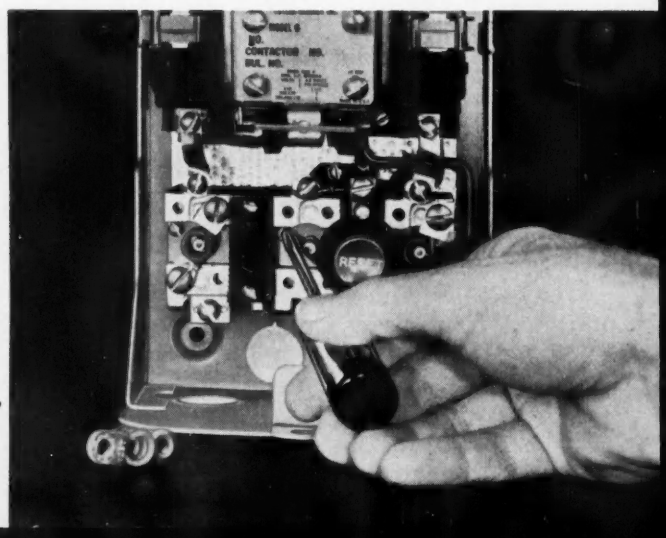
See "FOLLOW THE SUN" weekly, ABC-TV Network



Brown means melamine phenolic on popular new Cutler-Hammer AC magnetic starters. And melamine greatly improved di-electric performance of contact blocks, covers, contact-carrying drive bars—particularly in resisting tracking and arcing.

Cover control conversion is easy with new kit on all sizes 00 through 5. Provides choice of reset only, start-stop or three-position selector from kits stocked by Cutler-Hammer distributors.

Get 3rd coil protection on any Cutler-Hammer starter by adding a spindle and coil to standard block on all new starters. No additional control or power circuit wiring—no extra overload relay to add.



New melamine moldings, new 3rd coil protection, new operator conversion kit

These 3 improvements make Cutler-Hammer starters even more dependable, more economical to stock

Greater convenience, greater performance are yours in the improved Cutler-Hammer AC magnetic motor starters. Convenient, because any new Cutler-Hammer starter can be easily adapted in the field to provide 3-coil overload protection where required, as well as the cover control arrangement you want.

BETTER ELECTRICAL PERFORMANCE

New melamine-phenolic molding add an advance in the science of plastics to Cutler-Hammer Motor starters' electrical performance. Because melamine is many times as resistant to moisture, problems of arcing and tracking are virtually eliminated in the key moldings it replaces.

FIELD CONVERSION KITS

While starters are available from stock with any of the 3 types of cover controls, easy-to-stock kits now make it possible to change any Cutler-Hammer starter from reset-only cover control to start-stop or three-position selector switch.

The same principle now applies to overload protection. Addition of an inexpensive spindle and a coil will provide 3-coil protection for any Cutler-Hammer starter destined for isolated or unattended operation.

All this is in addition to top reliability, quick availability, long contact life and easy maintenance that have made Cutler-Hammer starters the smart buy for years and years.

For complete information on the starter line designed to industrial standards, proven in thousands of applications and exceeding NEMA requirements in every respect send for publication LO-70-Q241. Then see your Cutler-Hammer Distributor for quick service on the next starter you need.

WHAT'S NEW? ASK...

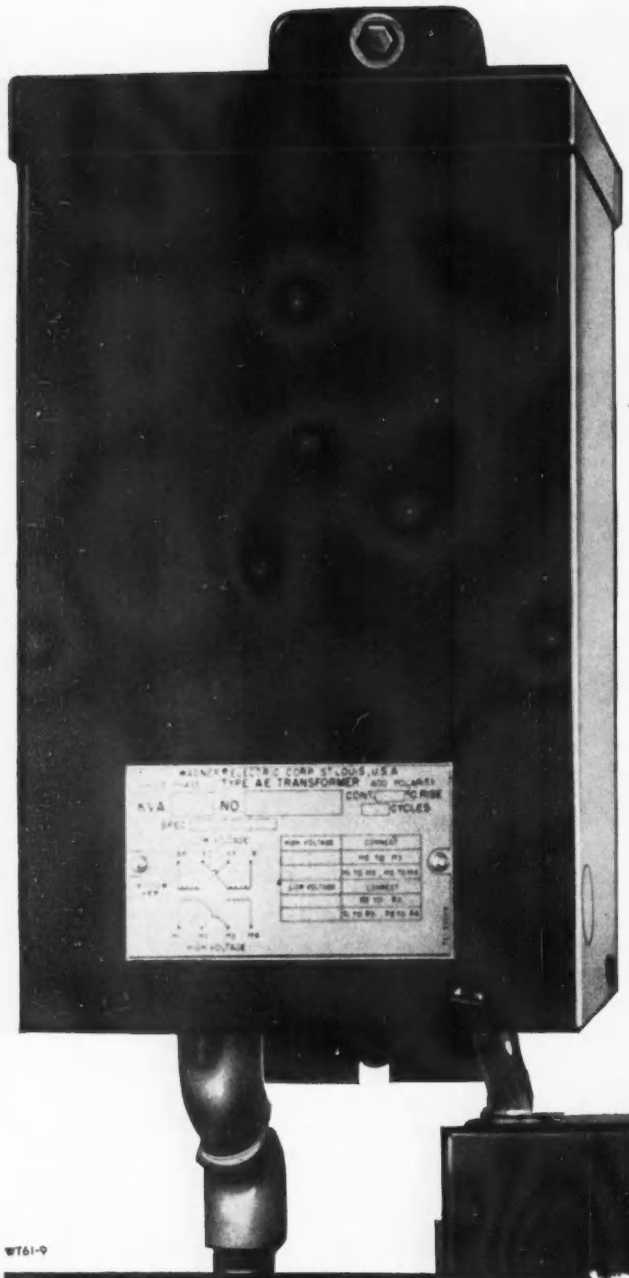
CUTLER-HAMMER

Cutler-Hammer Inc., Milwaukee, Wisconsin • Divisions: AIL; Mullenbach • Subsidiaries: Uni-Bus, Inc.; Cutler-Hammer International, C.A. • Associates: Cutler-Hammer Canada, Ltd.; Cutler-Hammer Mexicana, S.A.

WAGNER® DRY-TYPE GENERAL PURPOSE TRANSFORMERS

Compact Epoxy-Filled Units that

WHISPER WHILE THEY WORK



Unusually small in size (the 10 kva rating is less than a foot-and-a-half high), Wagner® totally-enclosed Type AE Single Phase Transformers can be used for general purpose applications. They have a low sound level, the result of encasing small Wagner Form W core and coils in a solid block of epoxy compound . . . to give you a whisper-quiet transformer that can be used anywhere noise would be a nuisance.

Available in ratings from 1 to 10 kva, Wagner Type AE Transformers have insulation protection suitable for continuous operation at 80°C in a 30°C average ambient. All parts are sealed from dust, moisture, and corrosion by the epoxy compound. Every unit is built to conform to all applicable standards of ASA and NEMA.

Wagner Type AE Transformers can be installed indoors or out in any location where they will not be submerged or exposed to injurious fumes in concentration. Compact and lightweight, they require no fireproof vaults and can be mounted indoors in any position, at any angle, on wall, floor, or ceiling. These transformers are carried in stock at Wagner branches and distributors. There's one near you, listed in your 'phone book. Call or write now.

Wagner Electric Corporation
6413 PLYMOUTH AVENUE, ST. LOUIS 33, MO., U.S.A.

WT61-9

SPECIFICATIONS

Type AE—Single Phase—1 to 10 Kva 80° C Rise, 60 Cycles.

High Voltages: 120 x 240; 240 x 480; 600 volts, no taps; 480, 600 volts, 2—5% taps below normal.

Low Voltage: 120/240 volts.

KVA	DIMENSIONS IN INCHES			NET WEIGHT POUNDS	AVERAGE SOUND LEVEL DECIBELS
	Height	Width	Depth		
1	10 13/16	6 5/16	6 5/16	28	37
1½	11 13/16	6 5/16	6 5/16	34	38
2	13 1/8	6 13/16	7 3/16	46	38
3	14 1/8	6 13/16	7 3/16	62	39
5	15 5/16	9 3/4	9 1/4	93	39
7½	16 1/16	9 11/16	10 7/16	130	39
10	17 1/8	11 1/8	10 1/4	167	39

EASY DOES IT...

with the right lubricant for each cable-pulling job

Save time and money installing cable in conduit . . . protect cable from damage . . . assure service continuity . . . with a cable lubricant engineered for your job's requirements.

Because conditions vary from job to job—diameter and length of cable, kind of insulation, number of bends, friction in the duct—Burndy provides these four tested cable lubricants, for a variety of service conditions. One of the four is the Burndy lubricant for your job . . . ask Burndy to help you select the cable-pulling lubricant you need.

Burndy SLIKON, for cable covered with rubber, many kinds of plastic, or lead, for installation in steel or aluminum conduit.

Burndy ALBENTONITE CABLE LUBRICANT, for cables with polyethylene and similar insulations.

Burndy IMPROVED CABLE PULLING COMPOUND, specifically for lead-covered cable for installation in ducts of all types.

Burndy PROTECTANT 626, for lead covered cable for installation in ducts and manholes subject to flooding and other severe conditions.

BURNDY

61-10

NORWALK, CONNECT. BICC-BURNDY Ltd. Prescot, Lancs., England In Europe: Malines, Belgium TORONTO, CANADA

WHEN YOU CONSIDER FLUORESCENT LAMP BALLAST

PROTECTION

AUTOMATIC RE-SETTING

ADVAN THERMAL PROTECTION *guard*®

HERE'S THE PROOF!

TYPE BALLAST PROTECTION	CONDITION OF BALLAST AFTER OPERATION DUE TO:				BALLAST COST WITHOUT PROTECTION*	COST OF BALLAST PROTECTION*	BALLAST COST WITH PROTECTION*	COST OF REPLACEMENT BALLAST*	REPLACEMENT LABOR COST	TOTAL COST DUE TO PREMATURE DESTRUCTION
	TEMP. IN EXCESS OF U/L-CBM SPECIFICATIONS	HIGHER THAN NOMINAL LINE VOLTAGE	LAMP RECTIFICATION	LAMP FAILURE						
ADVAN-guard PROTECTION	OPERATIVE	OPERATIVE	OPERATIVE	OPERATIVE	$8.02	76c	$8.78	NO COST — NO REPLACEMENT NECESSARY		
NON-RESETTING THERMAL PROTECTION	REPLACEMENT NECESSARY	REPLACEMENT NECESSARY	REPLACEMENT NECESSARY	REPLACEMENT NECESSARY	$8.45	25c	$8.70	$8.70	$3.50	$12.20
POLYESTER FILL	REPLACEMENT NECESSARY	REPLACEMENT NECESSARY	REPLACEMENT NECESSARY	REPLACEMENT NECESSARY	$8.02	33c	$8.35	$8.35	$3.50	$11.85

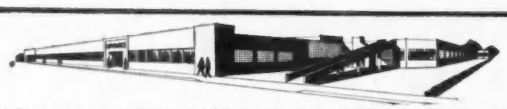
*BASED ON PUBLISHED LIST PRICES FOR 2 LAMP 96" CBM SLIMLINE BALLAST

The superior protection of ADVAN-guard® equipped Fluorescent Lamp Ballasts may cost a little more, but as the chart shows, it is protection that guarantees Fluorescent Lamp Ballast life.

Only ADVAN-guard®, a thermally actuated automatic reclosing protective device, is sealed in the ballast housing and is preset to automatically "trip-out" whenever the Fluorescent Lamp Ballast operates at abnormal temperatures. When heat decreases to normal operating temperatures, ADVAN-guard® resets automatically and the ballast resumes normal operation. If overheating continues, ADVAN-guard® protection continues. Through this continuous protection, the full life of ADVANCE Fluorescent Lamp Ballasts will be realized . . . rated life of ADVANCE Ballasts under normal operating conditions is 10 to 12 years.

End premature destruction and unnecessary ballast labor replacement costs, demand ADVANCE Fluorescent Lamp Ballasts with ADVAN-guard® built-in automatic resetting thermal protection.

"The Heart of the Lighting Industry."



ADVANCE® TRANSFORMER CO.

WORLD'S LARGEST EXCLUSIVE MANUFACTURER OF FLUORESCENT LAMP BALLASTS

2950 NO. WESTERN AVE. CHICAGO 18, ILL. U.S.A.

(In Canada: Advance Transformer Co. Ltd., 5780 Pare St., Montreal, Quebec.)

for the easiest, fastest, tightest connections — you need . . .

the WING

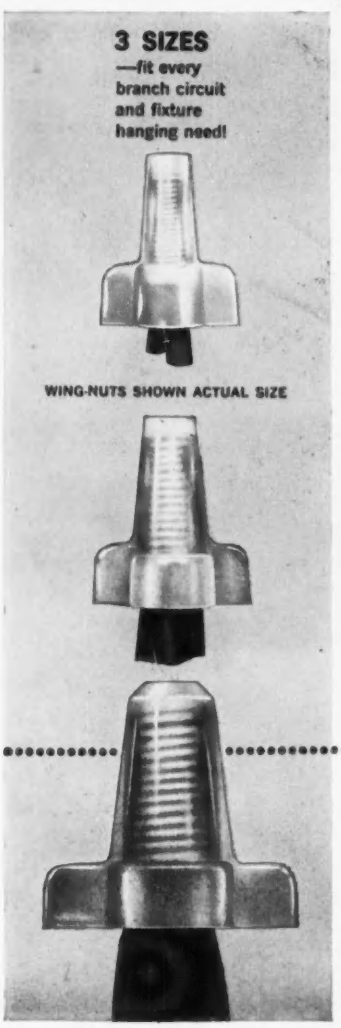
—the only built-in wrench, gives you terrific leverage . . . lets you **hand-twist** a perfect connection every time. Quickly splices even the largest, stiffest wires. Wings are easily clipped off for tight spaces.

the SPRING

—a tension-spring coil that expands as wires are fed into it—threads and crushes wires together—compensates for expansion and contraction with "breathing" action—a shake-proof, fool-proof lifetime splice.

the NYLON SHELL

—won't cold-flow, won't stretch thin and pop under pressure to short-out connections. WING-NUT is the **only** screw-on branch circuit connector with unbreakable, high-dielectric Nylon shell—the strongest, safest shell you can buy!



you get all three only with

Sold through America's Leading Distributors • In Canada: Irving Smith. Ltd., Montreal

Please send me a pocket-full of ***FREE SAMPLES***

Fill in and mail coupon, and Ideal will send you a **pocket-full** of WING-NUTS—plenty to let you see why they're America's most popular wire connector.

IDEAL INDUSTRIES, Inc., 1041-H Park Ave., Sycamore, Illinois

Name.....

Company.....

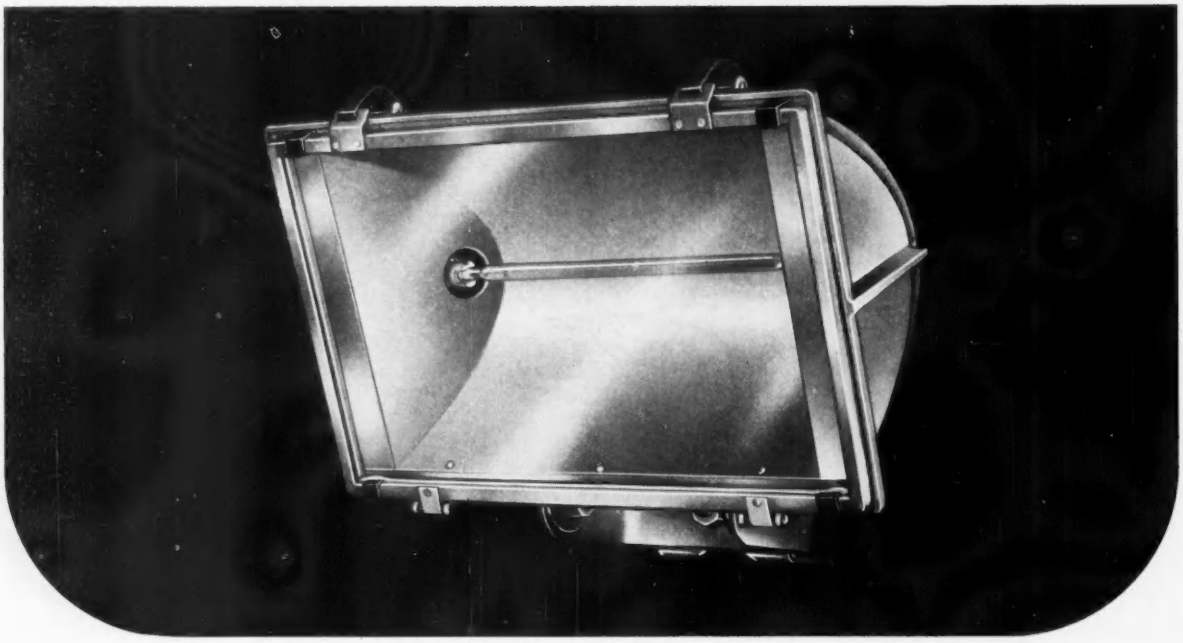
Address.....

City.....Zone.....State.....

STEBER

STEBER QUARTZLITERS ARE NOW DIE CAST!

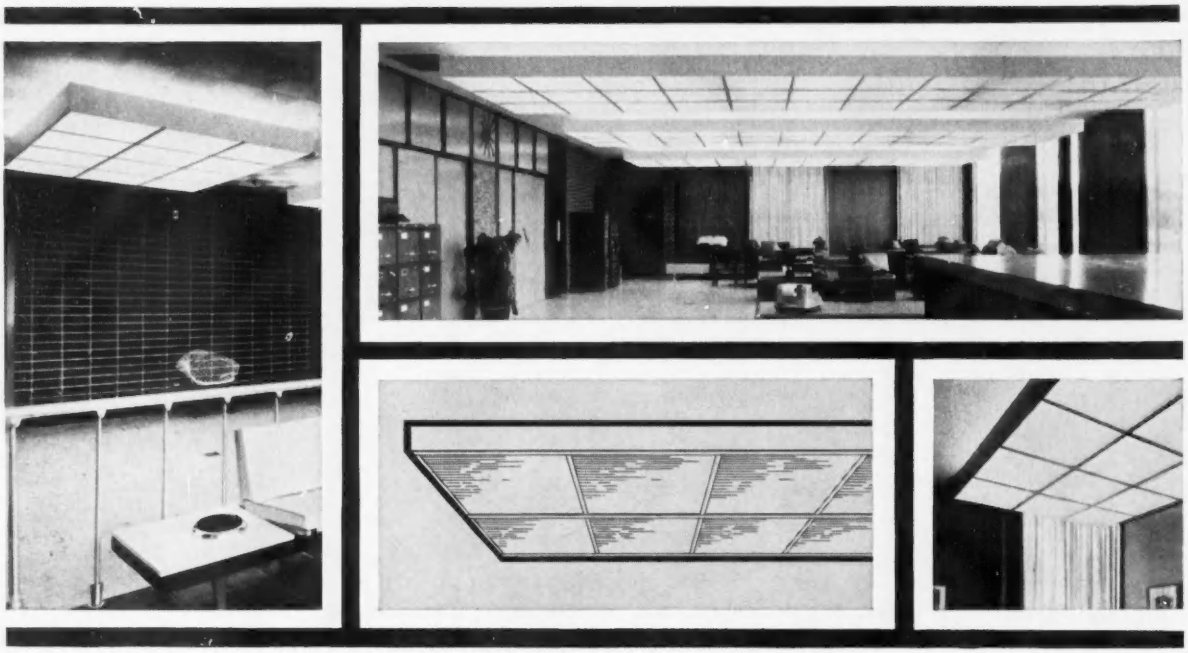
New Die Cast STEBER Quartzliters give you truer, full performance from 500 and 1500 watt quartz-iodine lamps. Wide, medium and narrow beam spreads to suit all applications for lighting building facades, signs and billboards, parking areas, sports areas, playgrounds and loading docks. DESIGNED FOR maximum controlled light output, efficient operating temperatures, economical cost ratio (first-cost versus light output) and versatility of application. FEATURES: die cast aluminum/aluminum anodal reflectors/thermal-shock and impact resistant lens/stainless steel hardware/metal to metal cooling—reflector nests in contact with internal fins which conduct heat to outer fin surfaces/available in externally wired yoke mounting (choice of brackets) or swivel mounting with enclosed wiring. Write Steber today for complete catalog information.



STEBER DIVISION THE PYLE-NATIONAL COMPANY 2700 ROOSEVELT ROAD BROADVIEW, ILLINOIS

WEST COAST: 245 ANDERSON STREET, LOS ANGELES, CALIFORNIA ALSO MANUFACTURED IN CANADA BY: PYLE-NATIONAL (CANADA) LTD. CLARKSON, ONTARIO

LPI Panelaire series offers design flexibility, visual comfort and high-level lighting



Here's a refreshing way for lighting specifiers to depart from conventional row-type fluorescent lighting installations. The Panelaire series utilizes large floating panels of light to achieve high levels of illumination while maintaining effective control of direct and reflected glare. □ Recent photometric measurements have shown that the widely accepted Panelaire complies with the brightness limitations of the "Scissors Curve" as recommended by the Illuminating Engineering Society. In addition, the large area of the light source minimizes reflected glare. □ The panels are designed for pendant mounting in square or rectangular patterns on a two-foot module. The bold, massive lines of the Panelaire harmonize with contemporary architectural designs and with existing ceiling structural elements in the case of relighting projects. With its wide choice of diffusers, the series is well suited for stores, offices, banks, foyers, lobbies, and high-bay fluorescent lighting. □ Please write LPI for complete Panelaire technical data.

LPI-2-212

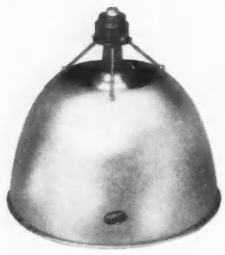
LPI FLUORESCENT LIGHTING

Lighting Products Inc., Highland Park, Illinois

sandwich protects equipment and people...by sandwiching vertical bus between sheets of polyester insulation. Stops spread of unit fault, blocks accidental contact. One of 44 features of the ***7700-LINE CONTROL CENTER*** for greatest protection, fastest installation, easiest maintenance available in grouped control. See your G-E Sales Representative or write for Bulletin GEA-7238 to Sect. 783-22, Schenectady, N. Y. *General Electric Co., Salem, Va. and Plainville, Conn.*

GENERAL ELECTRIC

High level lighting–down-to-earth costs



INSTALLATION DATA

Abolite HMFAU-2400 Alzak aluminum uplight fixtures with 1000 watt color-improved mercury lamps. Mounting height 30 feet, spacing on 20-foot centers. Average maintained footcandle level: 77

77 footcandles of light with only 50 Abolite fixtures—Maintenance crews working in this hangar need the best possible light for servicing intricate equipment. In designing the lighting, the choice was between a mercury or fluorescent system. Both could provide the required lighting level. But when it came to costs, lighting engineers decided in favor of Abolite fixtures equipped with 1000 watt color-improved mercury lamps. Here's how they figured it:

Lower initial costs. Only 50 Abolite fixtures needed as compared with 126 fluorescent reflectors (6 rows of 21 reflectors each). Only 50 mercury lamps needed as compared to 252 eight-foot maximum output fluorescent lamps.

Lower maintenance costs. With Abolite, 202 fewer lamps to be serviced. Longer lamp life, too—about 9000 hours average with high lumen output maintained. And Abolite fixtures are self-cleaning. Air circulating through their open-top sweeps them clean of dulling dust.

Lower operating costs. 52.5 kw connected lighting load for the Abolite mercury system vs. 61.7 kw for the fluorescent system.

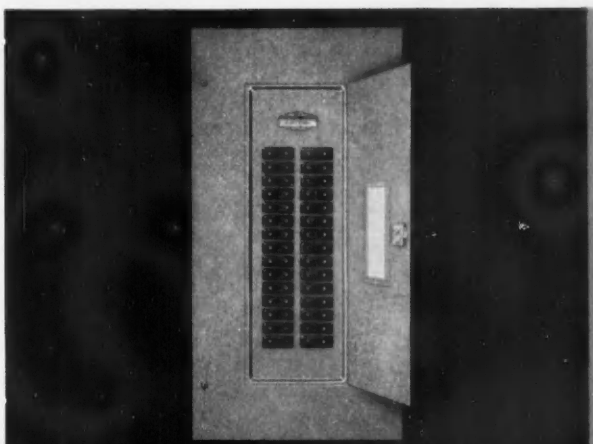
With all these cost-saving advantages, Abolite lighting was the obvious choice. Why not consider this system with Abolite fixtures on your next job? Full information is yours for the asking. Just write:

ABOLITE *Lighting*

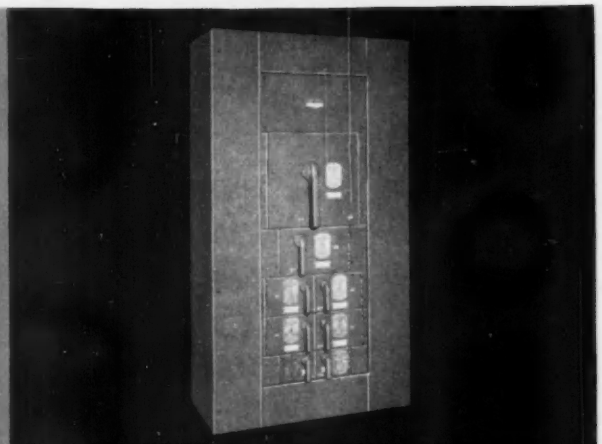
THE JONES METAL PRODUCTS COMPANY
West Lafayette, Ohio

FRANK ADAM ELECTRICAL EQUIPMENT

The Industry's Best Buy In Safety, Performance, Durability

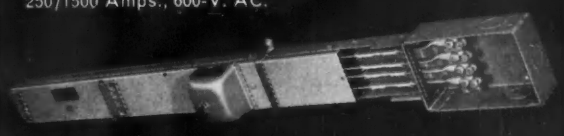


LIGHTING PANELBOARDS
Plug-In or Bolt-On Circuit Breaker Types.

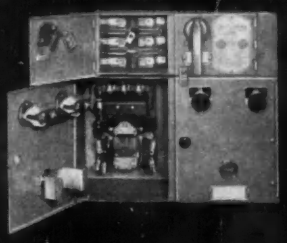


S-A-W DISTRIBUTION PANELBOARDS
Last Word in Heavy Duty Fusible Protection.

POWER PLUGIN BUSDUCT
Plug-In Outlets 10" Centers.
250/1500 Amps., 600-V. AC.



MIDGET BUSDUCT
Extends Busduct System for Less Than Wire, Cable and Labor Costs. 100 Amps. Unfused, Fusible or Breaker Plug-In Units.



NON-COMBINATION
Starter and Fusible Switch Assembled.

COMBINATION
Single Enclosure With Starter and Switch or Starter and Breaker.

PLUG-IN MOTOR STARTER UNITS
Plugs into Panelboards or Switchboards. Eliminates Separate Motor Controls.

No matter what the size and complexity of the project—no matter if the need is for the largest switchboard or the smallest safety switch—the Frank Adam name upon it is a warranty of unsurpassed quality and craftsmanship, protection and durability.

Give your clients every benefit in safety, dependability and economy of the "industry's finest"—specify, insist on, Frank Adam Electrical Equipment.

Write for catalog literature

FRANK ADAM ELECTRIC COMPANY

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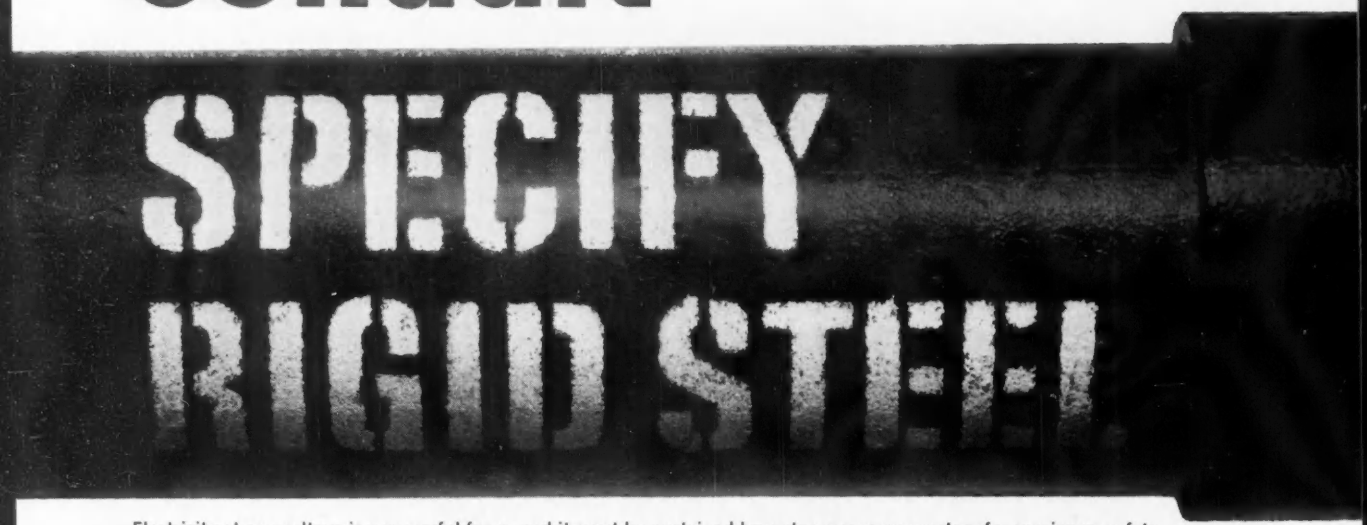
KEEP PACE WITH ELECTRICITY — PRODUCERS COUNCIL

This mark tells you a product is made of modern, dependable Steel.

specify safe conduit



Electricity at any voltage is a powerful force, and it must be contained by a strong raceway system for maximum safety. Steel conduit gives that strength—to withstand sudden power surges and overloading from the inside; impact and rough handling from the outside. Rigid steel conduit contains internal damage and protects conductors, insulation and wires from external damage.

Steel conduit offers additional safety because it gives a grounded metallic system, so induced currents are drained off without danger. It is simple to wire and rewire, so circuits can be serviced and changed quickly and easily. It is easy to install, requires few tools, and is easy to bend, cut and thread. It can be installed indoors or out, in dry or wet locations, concealed or exposed, in any hazardous location under all types of atmospheric conditions. You can even bury steel conduit, or run it through or along concrete, without organic covering. For strength, economy and long life, specify time-tested rigid steel conduit.

America's leading Steel pipe manufacturer supplying America's foremost conduit manufacturers

National Tube Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
United States Steel Export Company, New York

SECOND EDITION!*

* *Includes recommended design requirements on low velocity, piston-type tools.*

To: Powder Actuated Tool Manufacturers' Institute, Inc. ECM-8
200 College Street, New Haven 10, Connecticut

Gentlemen: Please send data on Powder Actuated Tools and a copy of the 2nd Edition of the recommended Uniform State Code.

NAME _____ TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

No representative will call, unless you so request.

For the best in powder actuated tool fastening, rely on these brand names of member companies: **NELSON/OMARK/RAMSET/REMINGTON/STAR**

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UniB

The first high-voltage butyl cable that combines • Extruded strand shield • A unique process providing uniform, contamination-free blending of ingredients • Simultaneous extrusion and vulcanization of strand shield and insulation for perfect bonding – and a virtually perfect electrode. **These three features of Anaconda UniBlend create a uniformity of dielectric strength previously unattainable, result in a cable:** Smaller in diameter • Lighter in weight • Of greater relia-

lend

High-Voltage Cable

bility • At lower cost—Anaconda UniBlend is another dramatic advance to come from the finest integrated research and manufacturing facility in the rubber cable field • For complete information, call the Man from Anaconda and ask about new UniBlend. There is no better high-voltage butyl.

62285

ASK THE MAN FROM
ANACONDA®
ABOUT UNIBLEND CABLES

TOOLS THAT MAKE MORE MONEY!

ACTUAL SIZE
THE NEW POCKET SIZE TOOLS!
The rugged, light weight No. 607 Indenter for ½" fittings is shown here full size.

B-M { THE ORIGINAL INDENTER TOOLS / THE ORIGINAL INDENTER FITTINGS

These are the tools and fittings that have revolutionized setting up thin wall conduit. B-M, the Original Indenter Tools have been working efficiently for over 25 years—doing more work easier and lowering installation costs. Now, B-M Indenters have been re-engineered and redesigned to reduce size and weight to increase efficiency and ease of operation. These B-M Indenters with the new patented compound leverage are now only plier size. They are lighter to carry, easier to use and the leverage does the work.

B-M, the Original Indenter Fittings go with B-M Indenter Tools like ham and eggs. Contractors who demand the best always call for the Original B-M Fittings for the soundest, most permanent installations possible. The fittings are concrete tight and vibration resistant. All steel, heavy gauge fittings are heavily bright zinc plated and have been salt spray and acid drip tested for corrosion resistance. Additional features are extra heavy bonding locknuts. Smoothly rounded edges or bushed throat type connectors make fishing easier and prevent damage to insulation.

For fast, safe installation plus complete protection always specify the Original B-M Indenter Fittings and the Original B-M Indenter Tools.

BM-21B ½" Connector
BM-22B ¾" Connector
BM-23B 1" Connector

BM-41 ½" Coupling
BM-42 ¾" Coupling
BM-43 1" Coupling

BM-51 ½" Offset Connector
BM-52 ¾" Offset Connector

BM PLIER SIZE INDENTERS
BM—No. 609 1" BM—No. 608 ¾"
BM—No. 607 ½"

BRIEGEL METHOD TOOL CO.

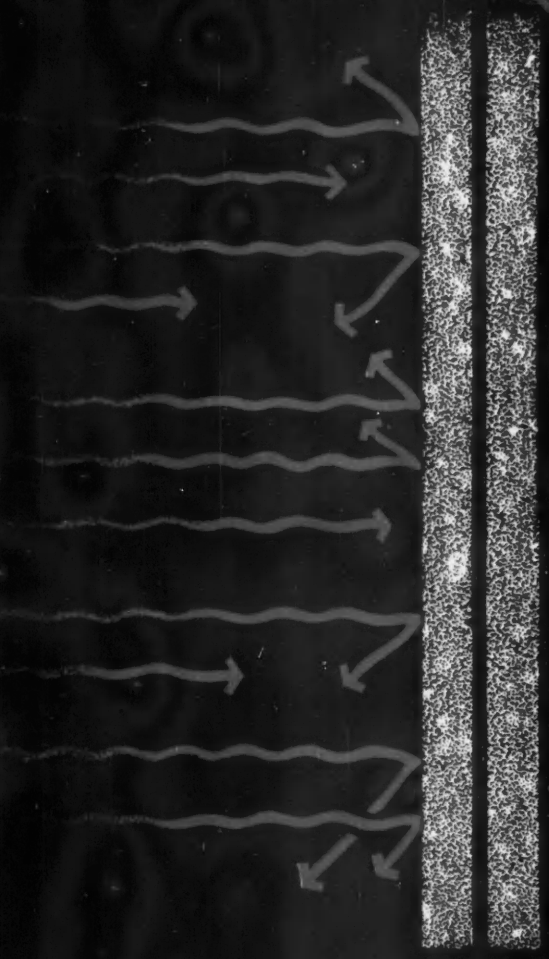
GALVA, ILLINOIS

All B-M indenter type fittings far exceed the requirements of U. L. file card E 10863 and Federal Specifications W-F-406.

*BM 51 and 52 offsets are not listed as concrete tight.

USED THE MOST FROM COAST TO COAST

NEW General Electric QHT Transformers



HEAT SHIELD

KEEPS WIRING COMPARTMENT COOL

MEETS NEW

REQUIREMENTS

REVISED U.L. STANDARDS FOR SAFETY restrict the type of cable used in making field connections to listed power transformers. To install such a transformer with low-cost 60C rated cable, the type you commonly use, no surface inside the wiring compartment can exceed 60C while the transformer is operating. New QHT dry-types pass this test easily . . . thanks to an exclusive G-E shield between the coil and the wiring compartment. MAKE SURE YOUR TRANSFORMERS MEET U.L. REQUIREMENTS FOR 60C CABLE . . . USE NEW GENERAL ELECTRIC QHT DRY-TYPE TRANSFORMERS. Get all the facts from your nearby G-E Sales Office or distributor. Or write Section 411-26, General Electric Co., Schenectady 5, N. Y.

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This catalog is really complete!

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Easiest-to-use catalog I've ever seen . . .

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Has everything for the construction market

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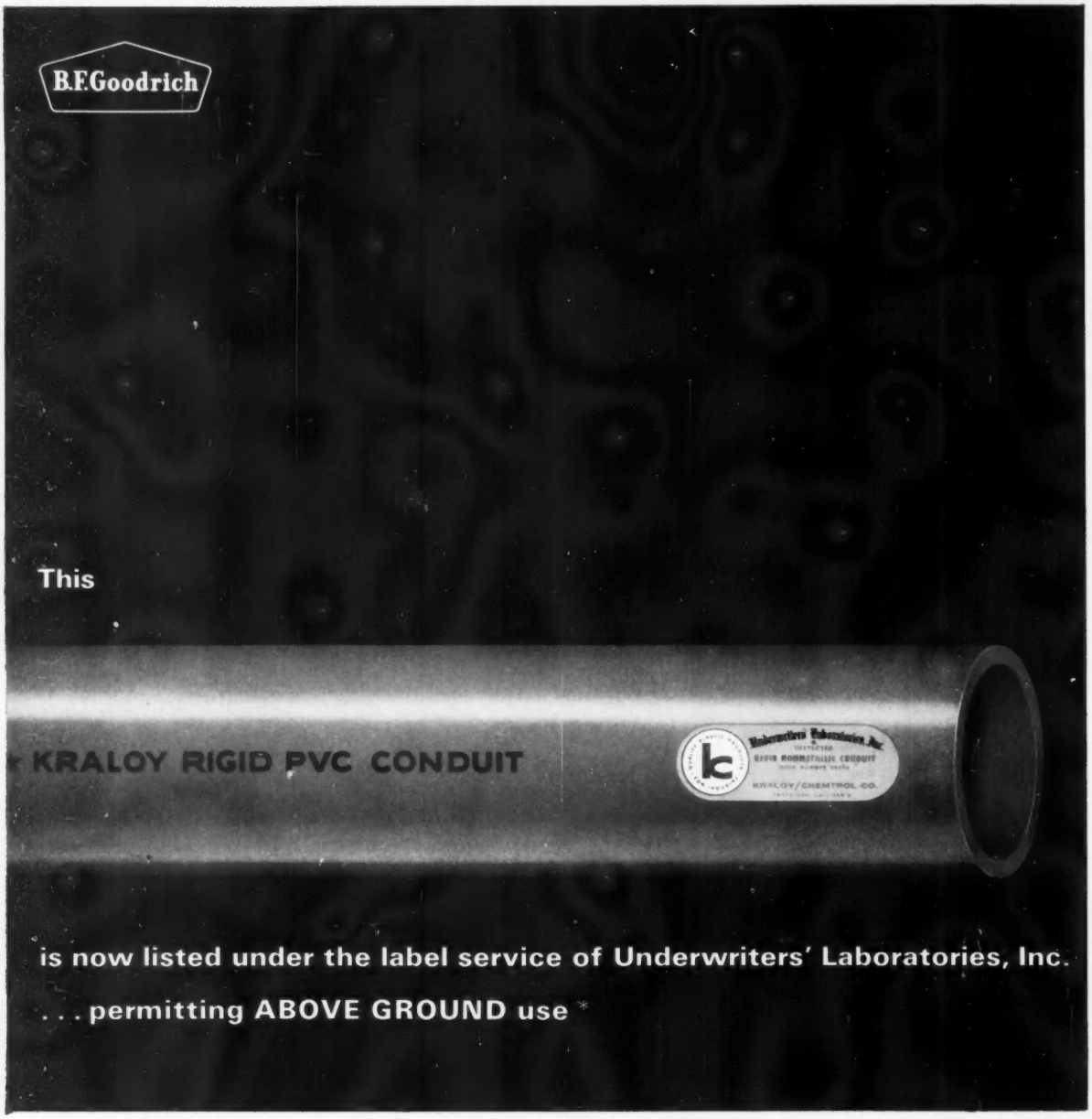
I-T-E CIRCUIT BREAKER COMPANY



Already, conduit made of rigid Geon PVC has shown performance superiority in many miles of below ground installations.

Now conduit made of Geon vinyl by Kraloy/Chemtrol, of Santa Ana, California, is included in the National Electrical Code for *above* ground use. Among the many advantages are these:

Corrosion resistance. Users report PVC conduit is their best answer to chemical attack by highly corrosive acids and alkaline fumes and vapors.

Fire resistance. Conduit of rigid PVC will not support combustion.

Unaffected by high humidity. Moisture and water will not penetrate rigid Geon.

Lower cost. Installation is quick and easy.

For specific information on the use and limitations of PVC conduit, consult the new National Electrical Code, *Article 347*, or write B.F.Goodrich Chemical Company, Department AL-4, 3135 Euclid Avenue, Cleveland 15, Ohio. In Canada: Kitchener, Ontario.

*Under provisions of revised National Electrical Code, Section 347.

B.F.Goodrich Chemical

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Geon® VINYLS

WIREMOLD® ELECTRIC IDEAS

PREPARED EACH MONTH FOR ELECTRICAL CONSTRUCTION AND MAINTENANCE TO BRING IDEAS, NEWS AND HELPFUL INFORMATION TO ELECTRICAL MEN

63rd YEAR

AUGUST 1962

Wiremold Economical for Wiring Fixture Showroom

Surface wiring systems prove less costly, more attractive in new lamp and fixture showroom

In the highly competitive field of fixture and lamp sales the importance of in-use displays cannot be overstated. Most buyers are more interested in how the fixture looks when lighted than in its lights-off appearance.

Recognizing this, more and more displays have turned to multi-outlet systems to assure plenty of conveniently located receptacles.

Typical of this concept is the warehouse and showroom building of Shemitz Lighting Co., Milford, Conn.

To provide for the needed outlets in as inconspicuous and flexible a manner as possible, it was decided

continued on third page

EXPOSED RACEWAYS blend with over-all ceiling decor in this modern fixture showroom. Wiremold systems proved both economical and practical for this application.

Advertisement

Code Comments

Lighting Branch Circuits

Q. *May additions be made to existing general lighting branch circuits?*

A. Section 220 (2) (d) (Existing Installations) states: "Additions to existing installations shall conform to the following:

"(1) Dwelling Occupancies. New circuits or extensions to existing circuits may be determined in accordance with Paragraphs 220-2(a or b); except that portions of existing structures not previously wired, or additions to the building structure, either of which exceeds 500 square feet in area, shall be determined in accordance with Paragraph 220-2(a).

"(2) Other Than Dwelling Occupancies. When adding new circuits or extensions to existing circuits in other than dwelling occupancies, the provisions of Paragraphs 220-2(a or b) shall apply."

Walk-In Refrigerators

Q. *Is it permissible to use surface metal raceways in walk-in refrigerators?*

A. No. Article 352-1 specifies: "Surface metal raceway may be installed in dry locations."

A walk-in refrigerator could be classified as a damp location according to Article 100 of the National Electrical Code, which defines damp location as: "A location subject to a moderate degree of moisture, such as some basements, some barns, some cold storage warehouses, and the like."

WIREMOLD®

Quiz Corner

Questions for this department are taken from inquiries received from the field. Your questions are welcome; indeed, they are necessary if this department is to serve you with worthwhile information. Address:

Quiz Corner
The Wiremold Company
Hartford 10, Conn.

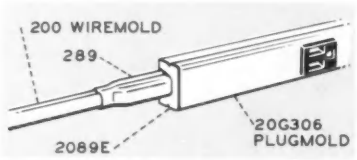
Q. *Is there a 2-gang switch and receptacle box available for Wiremold 1000?*

A. Yes, 1048-2 is available on special order.

Q. *Do you have a duplex 2127D lumiline receptacle?*

A. No, but two 2127D can be used back to back.

Q. *How do I connect Wiremold 200 to Plugmold 20G306 horizontally?*



A. Through the use of a 2089E end reducing connector and a 289 reducing connector.

Q. *What size quarter round does the 2617T accommodate?*

A. With cover twistouts removed and base broken at scores, the 2617T will accommodate 3/4" quarter round molding.

Q. *What is the maximum number of circuits that can be used in Wiremold 2100?*

A. Maximum number of circuits allowed in 2100 or any raceway is determined by the maximum number of conductors allowed in the raceway. No. 2100 has a maximum capacity of 14 No. 12 TW conductors without devices. This would permit seven two-conductor circuits, or a total of nine circuits where a combination of 2- and 3-wire circuit arrangement is used.

Q. *Is there a 215 tee for Wiremold 200?*

A. No, use the 228 adjustable junction box.

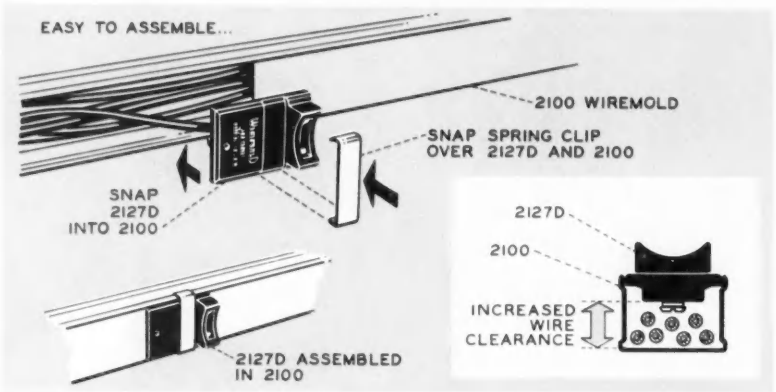
WIREMOLD®

Product of the Month

Improved lumiline receptacle available

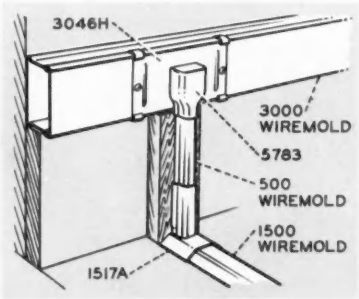
The redesigned 2127D Lumiline Single Receptacle has many refinements designed to make it simpler to use.

The neck of the lamp holder has been made deeper, providing more clearance between lamp and reflector. Fastening to the raceway has been streamlined — simply put the 2127D in place and fasten with spring clip furnished. The terminal has been redesigned to provide greater wire clearance and permit connection by through wiring.



Correction

In the July issue, art work illustrating connection of Pancake® 1500 on floor to Wiremold 3000 above 3/4" x 5½" wood base incorrectly labeled the short run of 500 Wiremold as 200 Wiremold. Corrected drawing follows:



WIREMOLD ■ HARTFORD 10, CONN. E2-8

Gentlemen: Please send free the checked items

NAME _____ ☐ Contractors' Electrical Equipment reprint

COMPANY _____ ☐ Electric Ideas, July, 1962

ADDRESS _____ ☐ Electric Ideas, June, 1962

_____ ☐ Wiring Guide (Catalog 22)

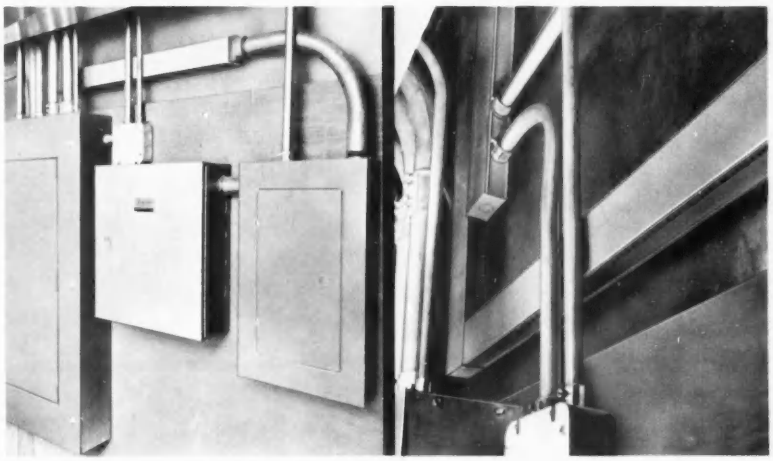
Advertisement

Wiremold Economical For Wiring *continued from first page*

SHOWROOM and warehouse is of curtain wall and solid masonry construction. Surface wiring systems were chosen for ease of installation and flexibility.

WIREMOLD 3000 risers come from basement panels. Left run is from lighting panel, right run from power panel.

CIRCUIT BREAKERS mounted in 3000 raceway protect branch circuits. Plugmold 2000 was used to assure enough outlets.



CONDUCTORS from power panel (left) and lighting panel (right) are carried to Wiremold risers. Photo on right shows detail of hook-up.

to use Wiremold 3000 as a feeder and subfeeder system and Plugmold 2000 with three-wire duplex switched outlets at 30-in. intervals.

A 400-amp. service entrance was provided, breaking to a power panel and to a separate lighting panel for the 18 display circuits.

The lighting panel was serviced with 120/208-v., 3-phase, 4-wire, 100-amp. service protected by three 50-amp., 2-pole; two 20-amp., single pole; and two 30-amp. single pole breakers.

From the lighting panel, nine No. 6 conductors were fed through conduit to a run of 3000 in the basement. The encased wires continue up the basement wall to the selling floor above. Because the structure overhangs the foundation approximately 14-in., a short run was required along the floor to the wall.

From the wall, the 3000 is exposed on the ceiling. Branch circuits were tapped into Plugmold 2000 from the ceiling runs. Each circuit is protected by a 20-amp., single pole circuit breaker mounted two to each 3046KD housing directly in the raceway.

The Plugmold® runs also are exposed along the ceiling. Fixtures are plugged directly into the Plugmold receptacles so that their cords are virtually unnoticeable. Floor lamps are connected to the outlets either directly or by the use of temporary extension cords.

To permit switching sections of the individual circuits, the contractor — New England Electric Construction Co., Inc., Bridgeport, Conn. — wired pull switches into the 3000 at various intervals.

The contractor reports that not only were the Wiremold systems the best for lighting of fixtures in the showroom, but that they proved less costly than if installation had been made with concealed wiring.

The power panel services the heat pump, basement lighting and other auxiliary services. Power is brought to the showroom floor through a run of 3000 which is terminated after a short run up the showroom wall.

WIREMOLD®

Advertisement

Engineered Specials

Two-piece corner coupling developed for partitions

PROBLEM:

To be able to install and remove interior partitions at will and to provide electrical outlets on the partition.

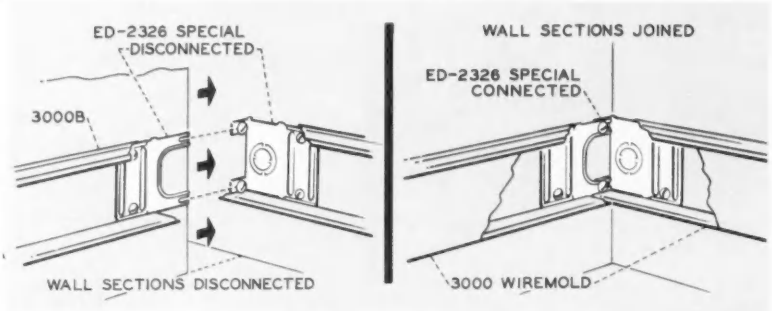
SOLUTION:

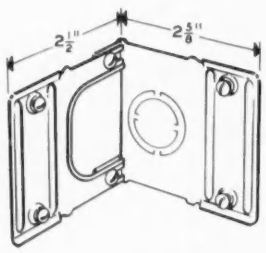
Plugmold 3000 was used for perimeter wiring and a special, 2-piece 3017TC Internal Corner Coupling was developed.

DISCUSSION:

The 2-piece 3017TC with separable legs made it possible to remove or install any partition with its Plugmold intact.

All that is needed to remove the wall is to remove the elbow cover, unscrew the two legs of the coupling, cut the wires, and carry off the partition. The perimeter wires are then re-connected. The reverse is done to install the partition.





Noteworthy

Three pole switch and box

A single fitting for Wiremold 200, 500 or 700 is available for use with a three pole switch.

The 57240B switch and box is furnished with a standard three-pole switch. The cover has twist-outs for the three raceway series on each end and each side, in position to permit running Wiremold close to interior trim.

The recently-developed 57240B is an illustration of the continual refinement of the Wiremold line of fittings to make them more convenient for you to use.

Worth Reading

Check coupon on second page for copies of listed item.

Multi-Outlet Raceway Distributes Power to Appliance Sales Area, Contractors' Electrical Equipment, July, 1962. A case history discussion of the wiring of a large appliance center in a new food-and-department store.

Practical Tips

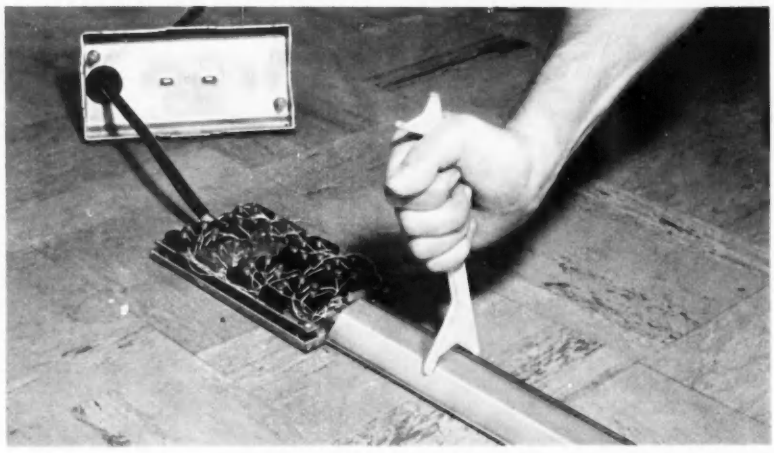
Cover removal tool aid in maintaining overfloor systems

The 656 Cover Removal Tool is designed to speed up the removal of the cover from Pancake 1500 and Pancake 2600 overfloor systems without twisting, kinking, or bending the cover section.

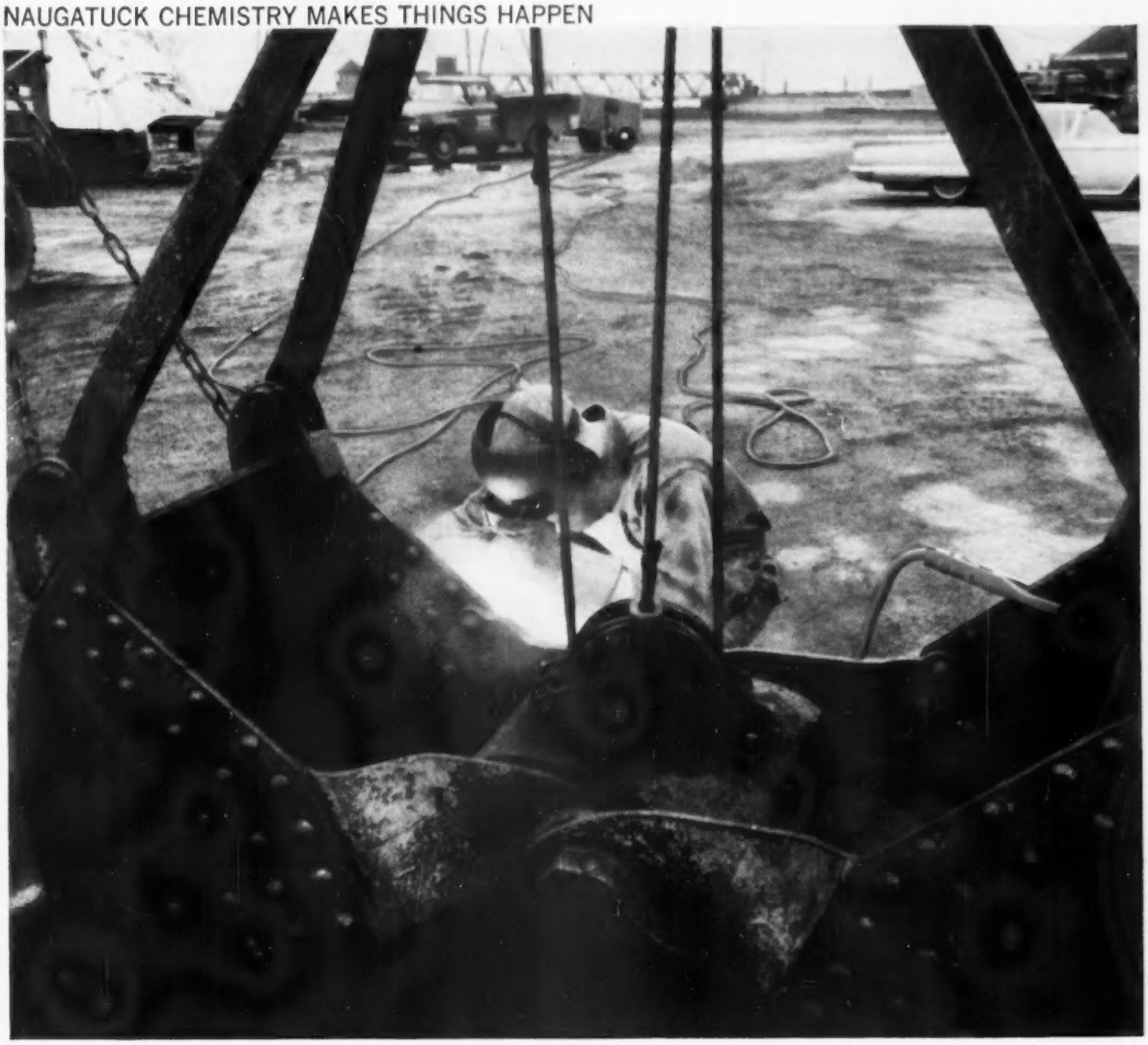
Each end of the tool is made to fit one of the two raceways and is stamped with the series number. It is easy to use and small enough to fit in any tool box.

To use the 656 tool, start at one end of the cover, or where the cover joins the fitting, and progress toward the opposite end. Firm and steady pressure should be applied, but care should be taken not to force the cover.

After removal, the cover may be re-installed by the normal method.



NAUGATUCK CHEMISTRY MAKES THINGS HAPPEN



Look what's new in welding cable!

PARACRIL OZO Nobody wants to trip over or accidentally cut an electric cable. A welding cable, particularly, carries a potential hazard at the business end, a high amperage, and a loss of dollars if service is interrupted.

Carol Cable Company of Pawtucket, Rhode Island, found an excellent solution to this constant hazard by jacketing its cable with tough, colorful PARACRIL® OZO. (Carol calls it VU-TRON 7.) The brightest, *lasting*, orange color calls instant attention to the cable even amid a profusion of other hose and cables such as found on a construction site. What's more, this unique blend of nitrile rubber and vinyl gives far superior resistance to attack from weather, ozone, oils and other solvents, and has outstanding resistance to cutting and abrasion. These new cables actually have five times the abrasion resistance of standard synthetic rubber after being exposed to oil! They're more flexible, too.

In short, PARACRIL OZO makes good welding cable better—safer, more durable than ever. And there's a good chance it can improve your product as well. If you'd like to combine toughness, oil and chemical resistance, and excellent color retention, check with your Naugatuck Chemical representative today.

Naugatuck Chemical

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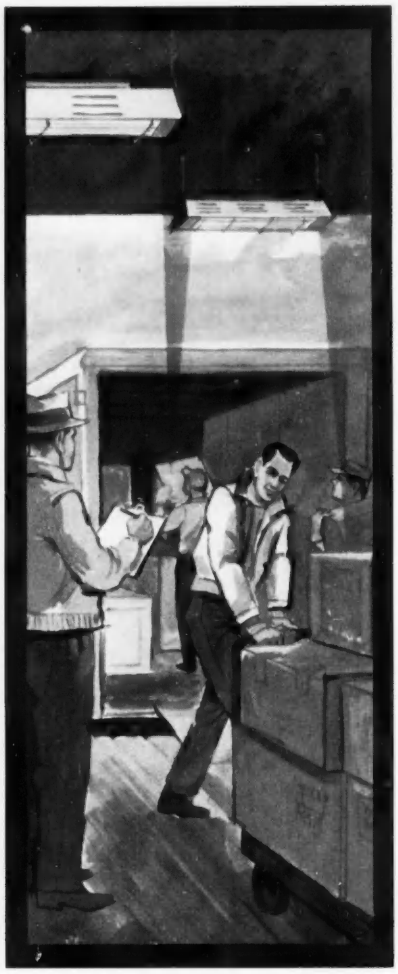
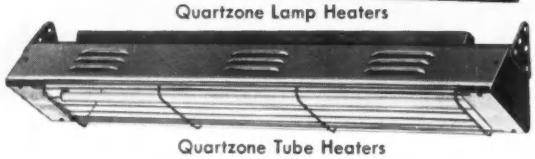


Electromode® QUARTZONE ELECTRIC RADIANT HEATERS

Quartzone Lamp Heaters



Quartzone Tube Heaters

COMPLETE LINE: Features more than 400 types, models and capacities of heaters and heating systems, all with exclusive Safety Grid. The solution to your heating problem is in the Electromode catalog.

Perfect for indoor and outdoor heating. Electromode Quartzone infrared heating is totally different from other types of heating in both principle of operation and sensation of warmth that is enjoyed. It is the nearest thing to natural sunlight, and is transmitted in much the same way. Infrared rays have a particular and useful characteristic. They speed through the air to heat only the persons or objects directly—and not the surrounding atmosphere. No heat is wasted enroute. That is why these heaters are often the only economical method of providing suitable warmth to persons in certain large and exposed areas. Some areas are impossible to heat satisfactorily otherwise. Infrared heaters therefore open up a wide avenue of new applications for controlled spot heating in home, farm, commerce and industry needs.

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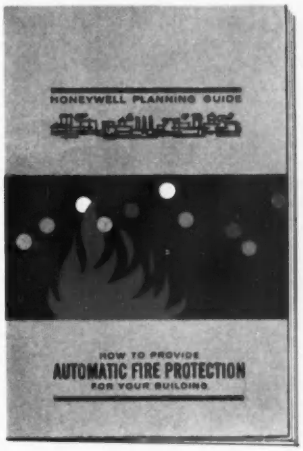

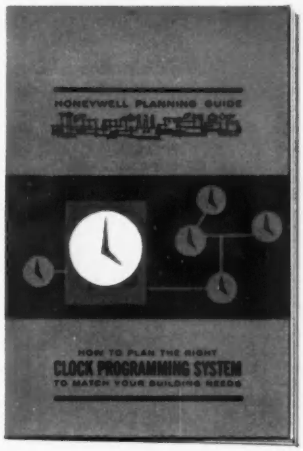

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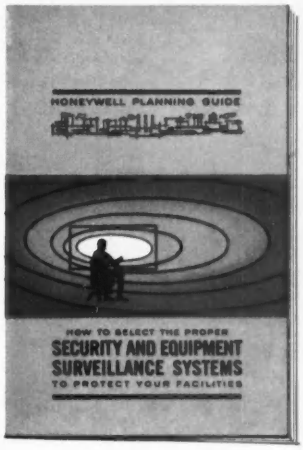

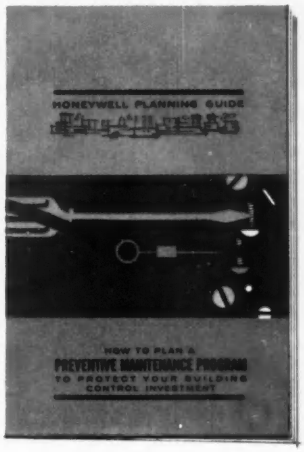

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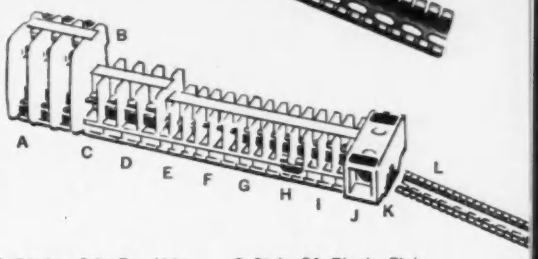

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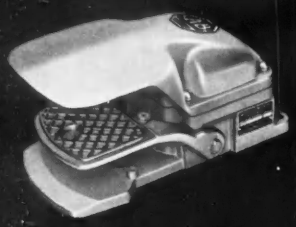

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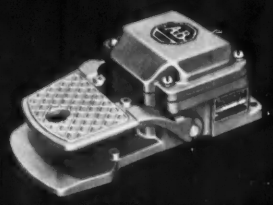

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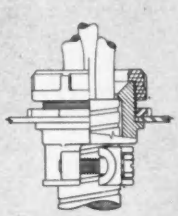
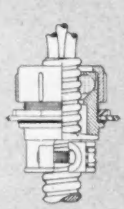
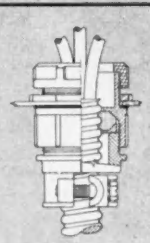
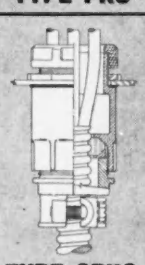
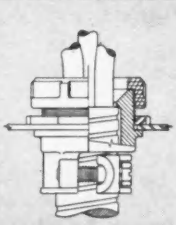
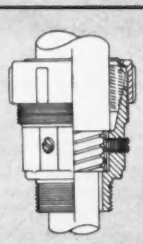
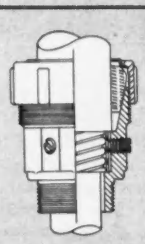
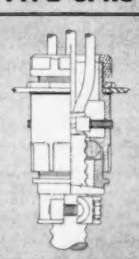
NON-JACKETED INTERLOCKED ARMORED CABLE	 TYPE PK	 TYPE PKG	 TYPE PKS	 TYPE PKC
NON-JACKETED CONTINUOUS ARMORED CABLE	 TYPE PK	 TYPE CPKG	 TYPE CPKS	 TYPE CPKC
INTERLOCKED & CONTINUOUS JACKETED ARMORED CABLE	 TYPE PK	 TYPE PG	 TYPE PG	 TYPE SPKC

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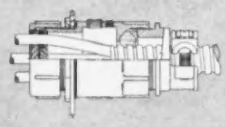
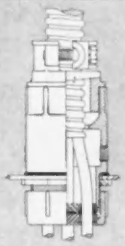
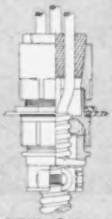
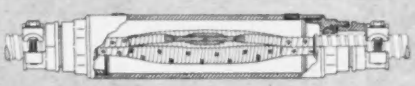
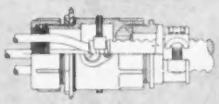
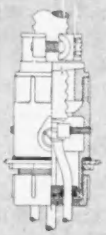
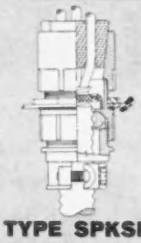
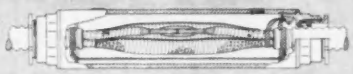
WATERTIGHT Horizontal — with Compound Chamber.	WATERTIGHT Inverted — with Compound Chamber.	VERTICAL SUPPORT TYPE	SPLICING FITTINGS
 TYPE PKH	 TYPE PKT	 TYPE PKR	PKJV-1  Non-Watertight: 600V Varnished Cambric Insulated Interlocked Armored Cable.
 TYPE CPKH	 TYPE CPKT	 TYPE CPKSR (WATERTIGHT)	CPKJV-5  Watertight: 5KV (Max.) Varnished Cambric Insulated Continuous Armored Cable.
 TYPE SPKH	 TYPE SPKT	 TYPE SPKSR (WATERTIGHT)	SPKJV-15  Watertight: 15KV Shielded Varnished Cambric Insulated Interlocked or Continuous Armored Cable.

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61ST YEAR • AUGUST 1962

ELECTRICAL CONSTRUCTION AND MAINTENANCE

Dynamic Floodlighting

The installation of "Lumadrama" at Independence Hall in Philadelphia last month marks the introduction in this country of a novel art form. It suggests that we may be on the threshold of an entirely new and much more sophisticated approach to the floodlighting of historical monuments and prominent buildings. It will be welcome. Fresh and original concepts in spectacular outdoor lighting have been surprisingly rare during a generation or more of nearly explosive developments in the art and science of illumination.

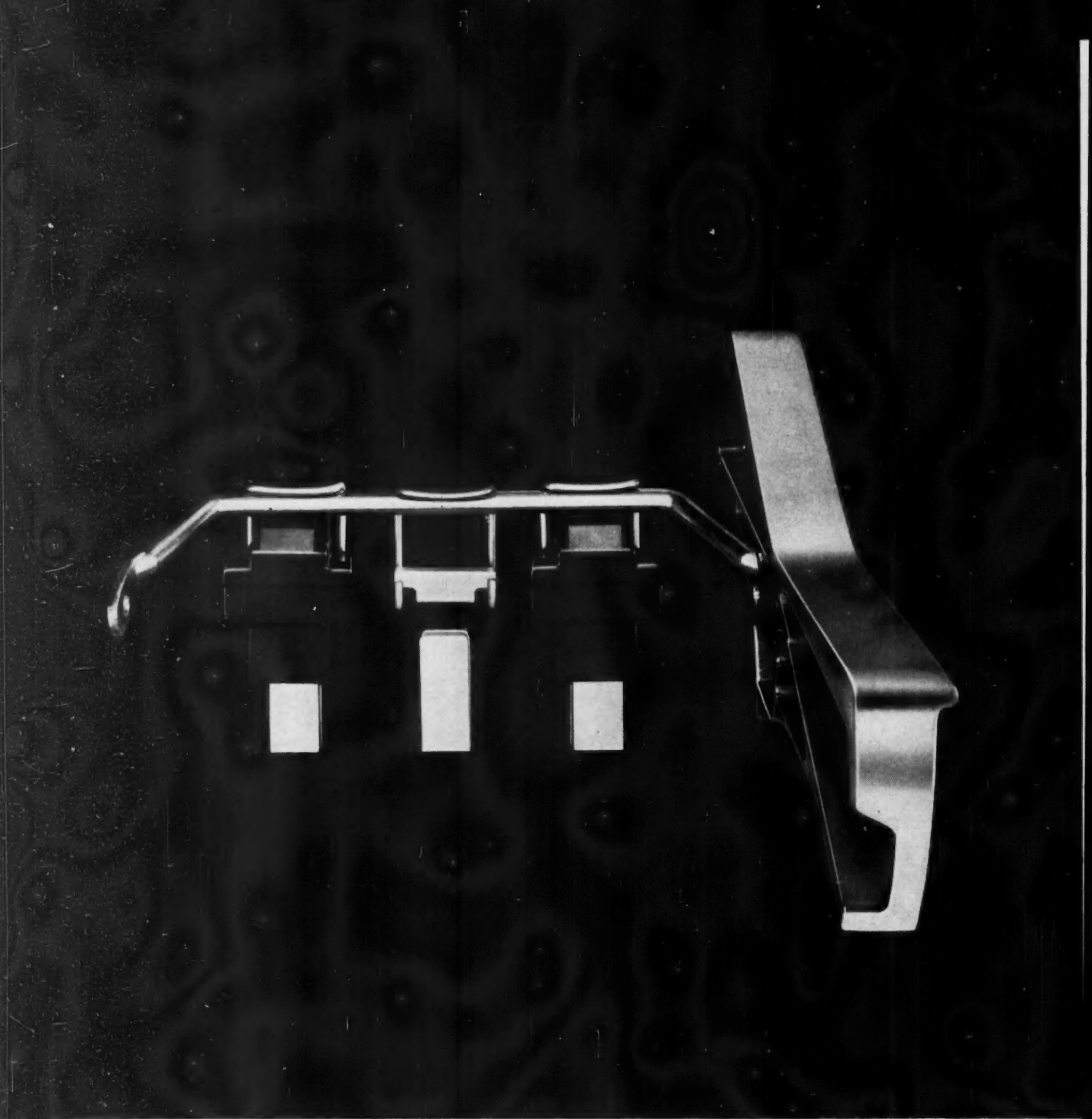
Lumadrama is primarily theatrical. A program of voices and music dealing with historical events are recorded on multichannel tape. The same tape also operates an elaborate sequence of synchronized lighting effects of great variety and beauty. The arts of dynamic theater lighting are applied to the illumination of a national shrine and the dramatic results should excite the creative imagination of lighting engineers and specialists everywhere.

Typical building facade lighting today is usually provided from fixed lighting sources giving uniform color and intensity. The Philadelphia installation dramatizes and exploits elements of lighting application, notably mobility, color, contrast and detailing, which have been singularly lacking in conventional building floodlighting practice.

Dynamic spectacular outdoor lighting is not new to the United States but its application to structures in recent times is uncommon. On the other hand fixed or static floodlighting of buildings is gaining rapidly in popularity. One of the most remarkable and attractive applications is the floodlighting of modern low industrial buildings in landscaped grounds along our highways. Even these modest installations could be brought to life with programmed dynamic techniques.

Once lighting specialists accept the challenge of dynamic floodlighting the prospects are limitless. There is no end to the variety of effects that can be achieved. Whether the subject is an historic courthouse or a Main Street bank building, each installation can have its own vivid individuality. As a starter we recommend a visit to Philadelphia's Lumadrama to see how dynamic lighting can make a building come alive.

Wm. T. Stuart



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ELECTRICAL
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HIGHLIGHTS OF THE

1962 National Electrical Code

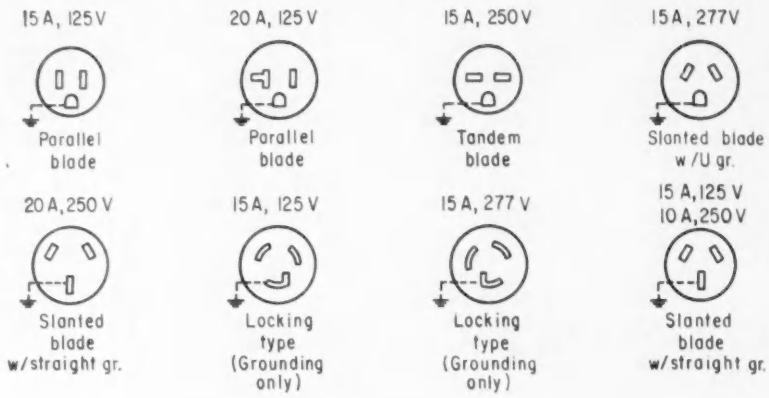
A review of the major code revisions that should influence new design and installation techniques for wiring, devices and utilization equipment.

By J. H. Watt

THE 1962 NEC has taken giant strides to keep abreast with technological advances in the electrical industry. Scheduled to be issued this September, the forthcoming code contains nearly 300 revised or new rules, in addition to four new code articles and several completely revised articles. The four new code articles prescribe regulations for rigid non-metallic conduit, aluminum sheathed cable, continuous rigid cable supports, and swimming pools. Other requirements cover such innovations as: only grounding-type receptacles permitted on 15- or 20-amp circuits; increased uses of 480Y/277-volt lighting; recognition of the principle of double insulation in lieu of grounding for certain portable equipment in residential occupancies; raising the voltage ratings of dry-type or askarel-insulated transformers (inside buildings) from 15 kv to 35 kv without the use of a vault; and recognition of new types of metal-clad cable (formerly termed armored cable).

Because of the vast number of

TYPICAL 15-AND 20-AMP GROUNDING-TYPE RECEPTACLES



Receptacles installed on 15- and 20-amp br. circuits shall be of the grounding type. P. 210-21 (b)

code revisions involved, it is possible to include in this article only those changes which seem to have the greatest impact on the design and installation of wiring and equipment. These changes are described under the code article in which they appear.

Article 100 Definitions

A number of new and revised definitions are included to clarify terms used in various parts of the code.

New definitions include those for: Fixed Appliance, Stationary Appliance, Attachment Plug (Plug Cap) (Cap), Receptacle (Convenience Outlet) and Utilization Equipment.

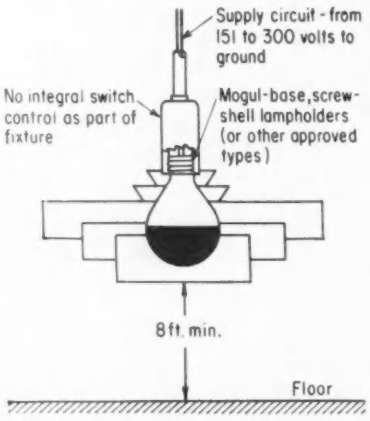
Revised definitions include those for: Appliance, Portable Appliance, Circuit Breaker, Explosion-Proof Apparatus, Externally Operable, Isolated, Voltage, and Weatherproof.

The new definition for Appliance states that it is "utilization equipment, generally other than industrial, normally built in standardized sizes and types, which is installed or connected as a unit to perform one or more functions such as clothes washing, air conditioning, food mixing, deep frying, etc."

A Fixed Appliance is "an appliance which is fastened or otherwise secured at a specific location." Typical examples would be waste disposers, wall-mounted ovens and counter-mounted cooking units.

A portable appliance is "an appliance which is actually moved or can be easily moved from one place to another in normal use." Some examples would be toasters, waffle irons, portable space heaters, and hand irons or similar small handheld, cord-equipped appliances.

A stationary appliance is "an appliance which is not easily moved from one place to another in normal use." Typical examples are freestanding ranges and clothes dryers.



P.210-6(a).Exception No.1 permits this arrangement in industrial plants or in stores where competent maintenance and supervision exist.

Article 210 Branch Circuits

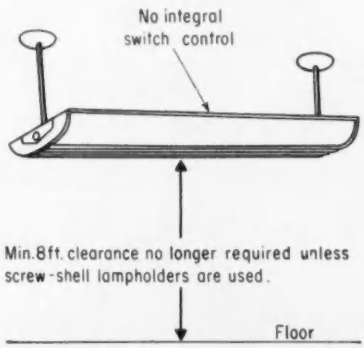
Paragraph 210-6 (a). Exception No. 1. Lighting fixtures equipped with mogul-base screw-shell lampholders (mounted not less than 8 ft from the floor and without integral switch control in the fixture) may now be used on circuits rated at 151 to 300 volts to ground—"in stores where the conditions of maintenance and supervision assure that only competent individuals will service the lighting fixtures." In such occupancies 480Y/277-volt circuits can be used to supply a combination of continuous-row fluorescent fixtures and mogul-base lampholders for incandescent lamps (added for "punch" lighting). Previously, this code rule applied only to industrial establishments.

Paragraph 210-6 (a). Exception No. 2. For circuits rated between 151 to 300 volts to ground, the previous rule that required permanently installed electric discharge fixtures to be installed at least 8 ft from the floor no longer applies unless the lampholders are of the screw-shell type. Because of this revision, further use of 480Y/277-volt circuits for fluorescent lighting can be expected.

Section 210-7. An exception has been added to permit the installation of a separate grounding wire from a grounded cold water pipe to the grounding contacts of grounding-type receptacles added to existing branch circuits not having a grounding conductor. But on new work, non-metallic type cables supplying grounding-type receptacles must contain a grounding conductor. The metal armor of Type AC metal-clad cable, the sheath of aluminum sheathed cable, or a metallic raceway is acceptable as a grounding conductor, except in the case of swimming pool equipment.

Paragraph 210-21 (b). Receptacles installed on 15- and 20-amp branch circuits shall be of the grounding type. However, receptacles installed on 30- or 50-amp branch circuits need not be of the grounding types because other code rules permit the grounded neutral conductor to serve as an equipment ground for ranges or clothes dryers served by 120/240-volt, 3-wire branch circuits. A major feature of

P.210-6(a). Exception No.2 applies to branch circuits (rated from 151 to 300 volts to ground) that supply ballasts for electric discharge lamps in permanently installed fixtures.



the grounding-type receptacle is that it will handle grounding or nongrounding type portable equipment. At the same time, the new code rule stresses that the installation of grounding-type receptacles shall not be used as a requirement that *all* portable equipment be of the grounding type. Section 250-45 specifically covers portable equipment which is required to be grounded. The installation of grounding-type receptacles must conform to Sections 210-7 and 250-74.

Paragraph 210-22 (b). All references to grounding-type receptacles have been deleted, and the first paragraph is the same as in the 1959 text except the word "usable" has been deleted in two places. With the new wording, the location of receptacles in dwelling-type occupancies should be easier to determine because the term, **usable** wall space, has been a source of controversy according to code authorities. By deleting the word "usable" a few more receptacles may be required in each new dwelling-type occupancy.

Article 220 Branch-Circuit and Feeder Calculations

Paragraph 220-3 (b) now requires two 20-amp appliance receptacle branch circuits in the kitchen of a dwelling-type occupancy. However, either or both of these circuits can supply receptacles in a dining room, laundry, pantry or breakfast-room.

Article 230 Services

Section 230-26. A new paragraph recognizes the use of a mast-type service riser to support the service drop to low-roof buildings. Proper construction and support of the mast is required. Complete details for mast services are usually covered by local utilities or local inspection authorities.

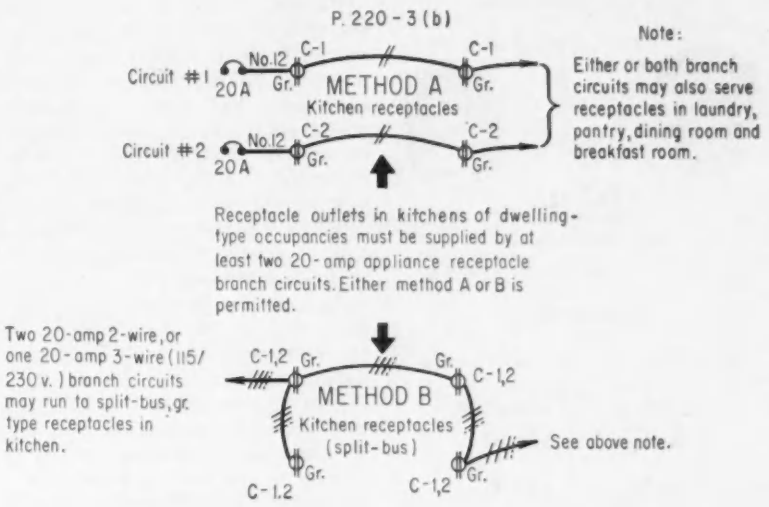
Section 230-44 adds wireways to the list of approved wiring methods for service-entrance conductors.

Paragraph 230-101 (h) now permits service-entrance conductors on circuits over 15 kv to enter metal-clad switchgear in lieu of a transformer vault.

Article 240 Overcurrent Protection

Paragraphs 240-5, Exception No. 1; 240-6 (a); and 240-7 (a) permit the next larger size or rating of overcurrent device, when conductor carrying capacities do not correspond to standard overcurrent device ratings, but only where the rating is 800 amps or less. This affords better protection for conductors in the higher ampere ratings.

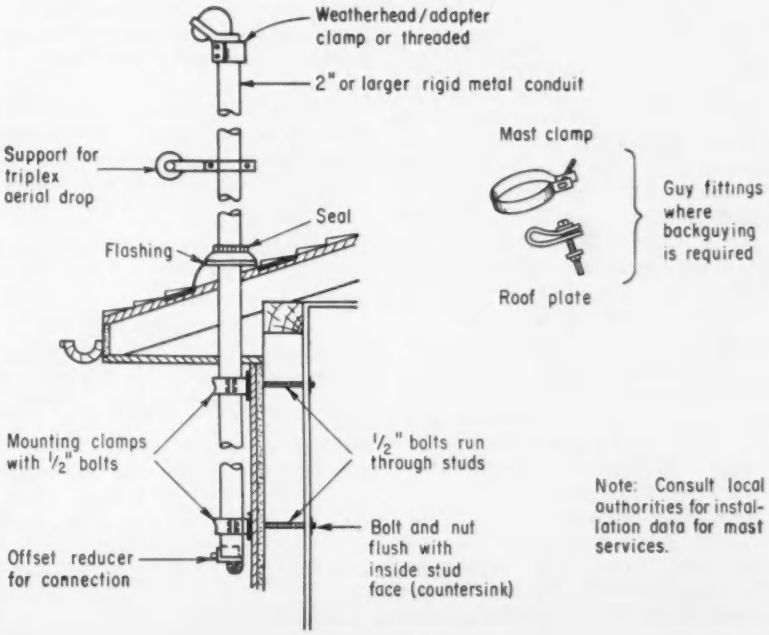
Paragraph 240-22 (a) changes the classification of Type S fuses and fuseholders into three groups—0 to 15 amps, 16 to 20 amps, and 21 to 30 amps. Ratings in these classifications have been available for a number of years, but the code had previously called for only two classifications.



Paragraph 240-23 (a) (2). Additional classifications for cartridge fuses and fuseholders rated over 600 amps are: (1) 601 to 800 amps; (2) 801 to 1200 amps; (3) 4001 to 5000 amps; and (4) 5001 to 6000 amps. The new classifications will assure better protection for larger conductors.

New Section 240-30 recognizes supplementary overcurrent protection for appliances, motors, or other utilization equipment. Such protection is in addition to required branch-circuit protection. The major feature of this new code rule is

S. 230-26 REQUIRES RIGID CONSTRUCTION OF MAST-TYPE SERVICES



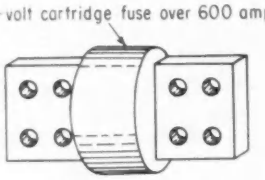
Type S fuses and fuseholders

P. 240-22(a)

New classifications:

0 to 15 amps
16 to 20 amps
21 to 30 amps

600-volt cartridge fuse over 600 amps



P. 240-23(a)(2)
New classifications for fuses and fuseholders

601 – 800A	2001 – 3000A
801 – 1200A	3001 – 4000A
1201 – 1600A	4001 – 5000A
1601 – 2000A	5001 – 6000A

that supplementary overcurrent protective devices need not be readily accessible. A common application of supplementary overcurrent protective devices would be where small fuses are inserted in line conductors supplying fluorescent lamp ballasts and are located within the fixture. But such fuses cannot be used as a substitute for branch-circuit overcurrent devices.

Article 250 Grounding

Section 250-23. New paragraph (a) is the same as Section 250-23 in the 1959 text. New paragraph (b) is a significant revision, which reads: **"Where** the secondary system is grounded at **any** point, the grounded conductor shall be run to each individual service. This conductor shall not be smaller than the required grounding conductor specified in Table 250-94 (a)." This new rule will apply even though the grounded conductor will not be used in the circuits supplied—because the grounded conductor, properly grounded at an individual service, provides a low-impedance grounding path to supply transformers and will permit the proper function of overcurrent devices if a line-to-ground fault occurs in an ungrounded conductor. However, Paragraph 250-23 (b) will not become effective until January 1, 1964.

Paragraph 250-45 (c) specifies the type of portable equipment required to be grounded when used in residential occupancies. No new equipment has been added, but chuck capacities no longer determine when electric drills should be grounded. On the other hand, the new exception to this paragraph could be a milestone in the prevention of electric shock for users of portable equipment. This exception recognizes the principle of double-insulation in the construction of the residential portable equipment listed in Paragraph 250-45 (c). Where such equipment incorporates this principle, grounding will not be required. According to UL, a number of appliance and tool manufacturers are interested in submitting equipment of this type for UL listing. Many authorities feel that the double-insulation features will be far superior to those depending on the integrity of a grounding conductor.

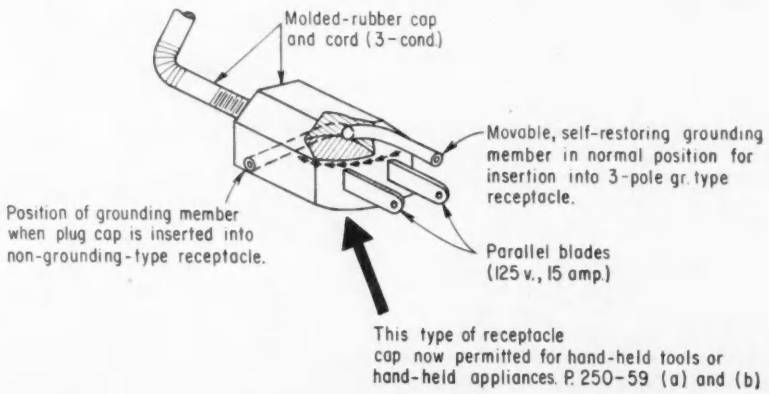
Paragraphs 250-59 (a) and (b). Previously, these code rules have required a grounding-type attachment plug containing one fixed contact member for the purpose of grounding portable equipment required to be grounded. An exception, which recognizes a new concept in grounding-type attachment plugs, now appears after paragraphs (a) and (b). This new grounding-type cap features a movable, self-restoring grounding contact member. As a result, the plug cap may be inserted into either a grounding-type or non-grounding-type receptacle. The permitted use of this special plug cap is limited to hand-held tools or hand-held appliances.

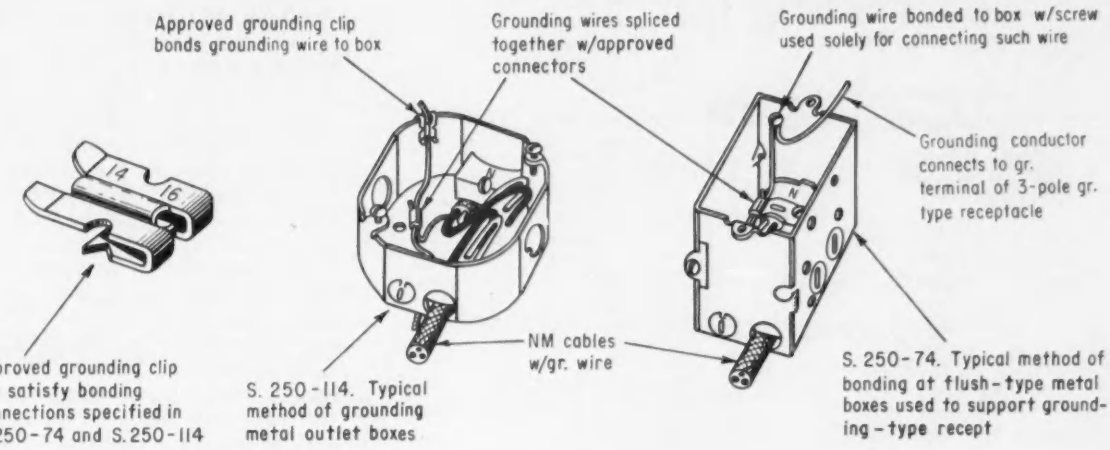
New Section 250-74 pertains to bonding at grounding-type receptacles where they are attached to grounded boxes. Usually a metal outlet box is grounded through connection to a grounded metallic cable or raceway, or by a grounding conductor of a non-metallic cable. Since the mounting strap and ground slot of a grounding-type receptacle are integrally bonded, the two metal attachment screws, securing the receptacle mounting strap to a properly grounded metal box, will afford adequate grounding conductivity to the receptacle ground slot if the screws are tight. However, in the case of flush-type boxes where the finish surface is soft material, such as plasterboard, a bonding jumper between the box and the ground-slot terminal on the receptacle may be necessary to insure a proper grounding connection. But in **any** event, it would be advisable to bond the receptacle ground-slot terminal to the metal box because of the importance of a reliable grounding circuit.

New Section 250-114. In effect, this code rule states that where a grounding conductor enters a metal outlet box it must be connected to the box by means of a grounding screw (used for no other purpose) or by an approved grounding device (such as the popular spring-steel grounding clip). Where several grounding conductors enter the same box they must be properly joined together, and a final connection made to the grounding screw or grounding clip. In non-metallic boxes, grounding conductors must be attached to any metal fitting or wiring device required to be grounded.

Article 310 Conductors For General Wiring

Table 310-2 (a). The new Type THWN wire is included in this table. This wire has a moisture and heat-resistant thermoplastic insulation with an outer nylon braid. It





is approved for use in dry or wet locations at a maximum operating temperature of 75°C. Made in sizes up to 500 MCM the THWN conductors have smaller over-all diameters than corresponding T or TW sizes, and would seem ideally suited for rewiring existing raceways or other uses where small-diameter wires are necessary.

Article 318 (New) Continuous Rigid Cable Supports

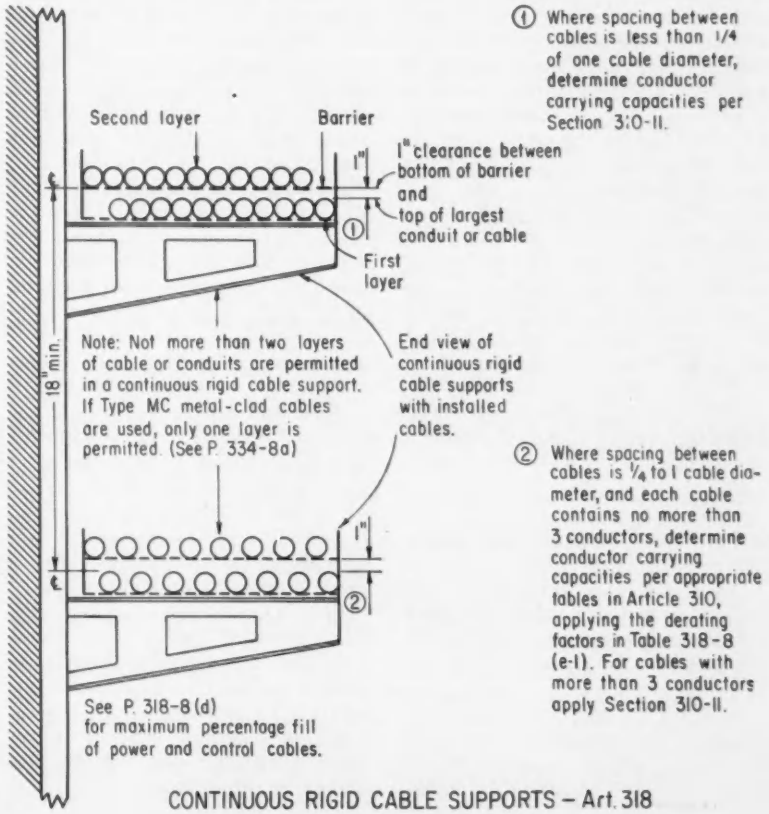
This new code article clarifies the status of so-called "ventilated cable trays or cable troughs." Such material now has code recognition only as a means of support for approved general wiring methods such as MI cable, metal-clad cable, non-metallic sheathed cable, SE cable, UF cable, and conduits with contained conductors. However, Section 318-8 does permit the development of factory-assembled, multiple-conductor control or signal circuit and power cables specially approved for use in continuous rigid cable supports installed in industrial or commercial occupancies. Indications are that these cables will be heavy-duty nonmetallic types, and should be available in the near future.

Other requirements for continuous rigid cable supports state that: (1) they cannot contain standard building wires such as Type R, T, etc.; (2) they may be used for exposed work in wet or dry locations only in areas of fire-resistive or non-combustible construction or other construction acceptable to the authority enforcing the code; (3) they are not permitted in hoistways, hazardous locations, and where subject to severe physical damage; (4) they are not recognized as an equipment grounding conductor or as a grounded (e.g. neutral) conductor; (5) they shall contain not more than two layers of cable or raceway, and where a second layer is installed, a 1-in. air space is required above the first layer (Type MC metal-clad cable is limited to one layer per Paragraph 334-8a); (6) the vertical spacing between continuous rigid cable supports shall be at least 18 in. center to center; and (7) splices and taps are permitted only in junction boxes or fittings approved for the purpose.

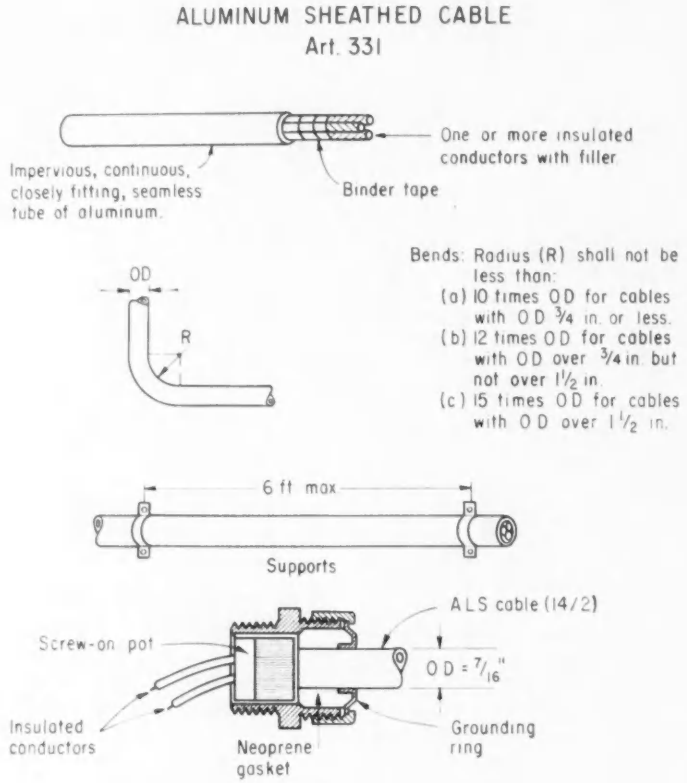
Section 318-8 describes the maximum percentage fill of cables in rigid cable supports and how to determine the fill. Derating factors are also included.

Article 331 (New) Aluminum Sheathed Cable—Type ALS

This new wiring method is a factory-assembled cable consisting of one or more insulated conductors enclosed in an impervious, continuous, closely fitting, seamless aluminum tube. While new in this country, aluminum sheathed cable has been widely used in Great Britain and Canada.



CONTINUOUS RIGID CABLE SUPPORTS – Art. 318



Typical cast aluminum connector

Major requirements for Type ALS cable are: (1) it may be used in both exposed and concealed work, in dry or wet locations (with certain precautions where the cable is exposed to destructive corrosive conditions); (2) it shall be secured at intervals not exceeding 6 ft, except where the cable is fished; (3) the radius of the curve on the inner edge of any field bend shall be not less than 10, 12 or 15 times the external diameter of the cable sheath, depending on the size of the cable; and (4) fittings approved for the purpose shall be used to connect the cable to boxes or equipment.

By reference to other code articles, Type ALS cable is not recognized for use in hazardous locations, for services, or for direct burial in earth.

Article 334 Metal-Clad Cable

This entire article, previously titled "Armored Cable," has been completely revised. Metal-clad cable consists of two classes—Type MC and Type AC.

In the Type MC series, the outer sheath is an interlocking metal tape or an impervious, closely fitting corrugated metal tube. Type MC cables will contain copper conductors No. 4 and larger or aluminum conductors No. 2 and larger; and the outer metal covering may be steel, aluminum, bronze or similar material. In the past, cables with metallic sheaths consisting of materials other than steel were not recognized by the NEC or UL. Therefore, the recognition of Type MC cable is another important industry advancement. At the same time, it does not appear that the code will recognize the metallic sheath of Type MC cables as a suitable equipment ground. And if this assumption is correct, such cables will include a grounding wire.

Type AC cable will include assemblies with No. 14 conductors and larger, and it is understood that the metallic sheath for Type AC cables will be limited to steel. Most of the previous rules in Article 334 of the 1959 NEC will continue to apply to Type AC cable.

Type MC cables are approved for both concealed and exposed work. Also, they may be used in wet locations if the metallic covering is impervious to moisture or the sheath, jacket or insulated conductors under the metallic covering are approved for the purpose.

Other new provisions include: (1) Type MC cable shall be secured at intervals not exceeding 6 ft (when attached to a surface) and within 2 ft from every box or fitting, except where cable is fished; (2) When Type MC cable is installed on grounded metal racks or continuous rigid cable supports, the cable shall be attached to the support at intervals not exceeding 10 ft horizontally and 2 ft vertically, and not more than one layer of such cables, separated from each other by a distance of one-quarter of a cable diameter, is permitted on a rack or other support member; and (3) The curve radius of the inner edge of any bend shall not be less than seven times the diameter of MC cable.

Article 336 Non-Metallic Sheathed Cable

Section 336-2. Type NM or NMC non-metallic sheathed cable may now contain conductors up to No. 2. Previously the conductors were limited to No. 4. The No. 2 NM cables should find wide use in frame buildings where feeders of this size are required.

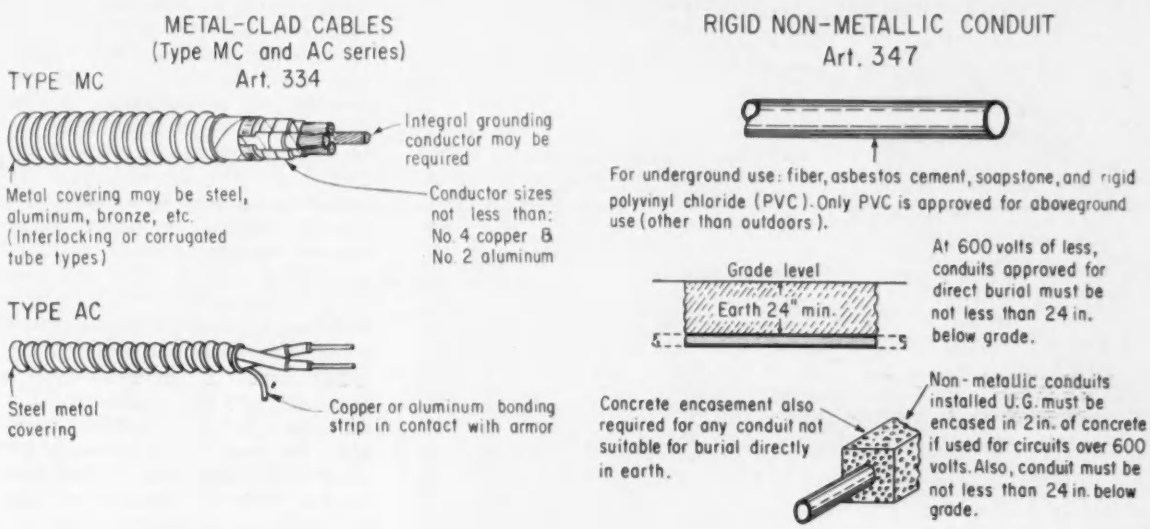
Article 339 Underground Feeder and Branch-Circuit Cable

Paragraph 339-3 (c) has been revised to read: "A minimum depth of 18 in. shall be maintained for (UF) conductors and cables buried directly in the earth, when supplementary protection from mechanical injury, such as a covering board, concrete pad, raceway, etc., is not provided." This is the first time that the code has specified a minimum depth for unprotected UF cables, buried directly in earth.

Article 347 (New) Rigid Non-Metallic Conduit

The provisions of this new article apply to types of rigid non-metallic conduits, which are resistant to moisture and chemical atmospheres.

For underground applications, the conduit must be acceptably resistant to moisture and corrosive agents and must have sufficient strength to withstand abuse, such as by impact and crushing, in handling and during installation. Where directly buried in earth, without concrete encasement, the conduit must also be capable of withstanding continued loading (such as backfill) which is likely to be encountered.



Present UL listings of non-metallic conduits for underground work include conduits and fittings constructed of fiber, asbestos cement, soapstone and rigid polyvinyl chloride (PVC). Each manufacturer's listing states the particular types of conduits that require concrete encasement or those that can be buried directly in earth. Therefore, it would appear that these UL listings serve a useful purpose in determining the application of rigid non-metallic conduits in underground work as covered in Article 347. On the other hand, there is one noticeable exception to this procedure. New Paragraph 347-2 (a) states that rigid non-metallic conduits shall be not less than 24 in. below grade in the case of direct earth burial; but if the conduits contain conductors operating on circuits over 600 volts, the conduits also must be encased in 2 in. of concrete. And, at all voltages, conduits not approved for direct earth burial must be encased in concrete.

For aboveground installations (other than outdoors), rigid non-metallic conduit is required to be flame retardant, resistant to impact and crushing, resistant to distortion due to heat under conditions likely to be encountered in service, and resistant to the effects of low temperature. According to the footnote following Section 347-1, only rigid non-metallic, polyvinyl chloride conduit is recognized for aboveground installations, such as: in concrete walls and floors, locations subject to severe corrosive influences, and wet locations. In these instances, PVC conduit can be used as a wiring method in buildings. But indications are that some other types of non-metallic conduits may have a similar recognition in the future.

Prohibited uses of rigid non-metallic conduit are: (1) above ground *outdoors*; (2) in hazardous locations; (3) in the concealed spaces of combustible construction; (4) for the support of fixtures or other equipment; (5) where subject to physical damage; and (6) where the conduit contains conductors operating on circuits over 600 volts in other than underground installations.

Table 347-8 specifies the maximum spacing of conduit supports. And the number of conductors permitted in non-metallic conduits is the same as specified for metallic conduits, except that increased fills are not permitted where rewiring existing non-metallic conduits.

Article 370 Outlet, Switch and Junction Boxes and Fittings

Table 370-6 (a-1) allows six No. 6 conductors in a 2¾-in. by 4⅛-in. square box. Since No. 6 conductors are often used on multi-outlet 50-amp branch circuits, the inclusion of such conductors in this table should be helpful.

Table 370-6 (b) adds a figure of 5 cu. in. for a No. 6 conductor where computing combinations of conductors not shown in Table 370-6 (a-1).

Article 410 Lighting Fixtures

Section 410-26. After Exception No. 2, a new sentence states that branch-circuit wires within 3 in. of a ballast shall be Type RHH or other types with a 90°C rating. This settles past controversies on what types of branch-circuit conductors are required where they are carried through continuous-row fluorescent fixtures. In such installations, the branch-circuit conductors will usually be within 3 in. of a ballast. While Type RHH conductors are specifically mentioned, other 90°C conductors, approved for branch-circuit wiring, would include Types SA and AVB. Also, Type AVA conductors, rated at 110°C, could be used.

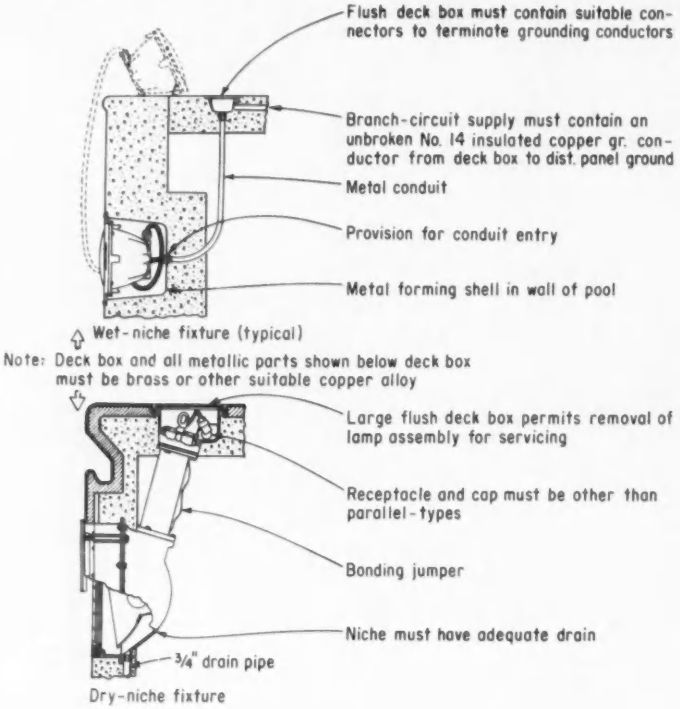
Article 450 Transformers and Vaults

Sections 450-21 and 450-23. These sections previously required that indoor dry-type or askarel-insulated transformers, rated over 15,000 volts, must be installed in an approved transformer vault. The 15-kv limitation has been raised to 35 kv. With this significant revision, designers can now use primary distributions for metal-clad unit substations in buildings at more than double the previous maximum voltage.

Article 600 Electric Signs and Outline Lighting

Section 600-6. This section has been revised to permit 20-amp branch circuits to supply incandescent lamps, fluorescent ballasts, and neon transformers, or combinations thereof when used for electric signs and outline lighting. A 30-amp branch circuit is permitted where only neon transformers are installed on the circuit.

NEW RULES FOR UNDERWATER SWIMMING POOL LIGHTING



Article 680 (New) Swimming Pools

The provisions of this article apply to the construction and installation of electric wiring for equipment in or adjacent to swimming pools, to metallic appurtenances in or within 5 ft of the pool, and to auxiliary equipment such as pumps or filters.

Section 680-4 covers the installation of lighting fixtures installed below the pool surface. Major requirements are: (1) maximum voltage to fixtures cannot exceed 150 volts, with a recommendation that all circuits for such fixtures should be isolated (for example, a 120-volt 1:1 transformer would provide an ungrounded supply to fixtures); (2) if the circuit voltage exceeds 30 volts, an approved fail-safe ground detector device which automatically de-energizes the circuit, or an approved grid structure (a grounded metallic shield to confine electrical fields) is recommended; (3) transformers used to supply fixtures, together with the transformer enclosure, shall be approved for the purpose, and the transformers shall be of an isolating type with a grounded metal barrier between primary and secondary windings; (4) approved metal forming shells, with conduit hubs, are required for the mounting of all underwater fixtures; (5) the metal parts of fixtures, fixture housings, and the supply conduits from deck boxes to forming shells shall be brass or suitable copper alloy; (6) approved "dry-niche" fixtures may be installed outside the walls of the pool in closed recesses which are adequately drained and accessible for maintenance; and (7) no attachment plug receptacles shall be installed within 10 ft of the inside walls of the swimming pool, with a minor exception where special receptacles are provided in dry-niche fixtures.

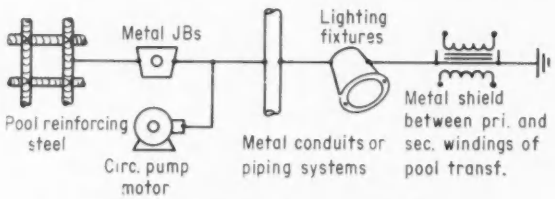
Deck boxes less than 4 ft from the pool perimeter or less than 8 in. above the finished surface shall be constructed of brass or suitable copper alloy.

Transformers and enclosures shall be approved for wet locations or shall be located not less than 4 ft from the pool perimeter and not less than 12 in. above the ground, concrete surface and water level.

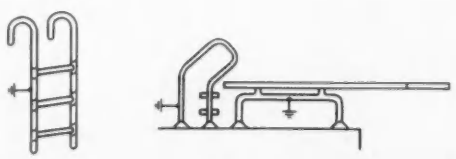
All metallic conduit, metallic piping systems, pool reinforcing steel, lighting fixtures, and the like, shall be bonded together and grounded to a common ground. In addition, the metal parts of ladders, diving boards, and their supports are required to be grounded. An unbroken No. 14, or larger, insulated copper conductor is required to be run from the deck box to the distribution panel ground.

This new code article is the result of extensive studies by a special technical subcommittee and several code-making panels.

SWIMMING POOL GROUNDING REQUIREMENTS



These metallic components must be bonded together and grounded to a common ground.

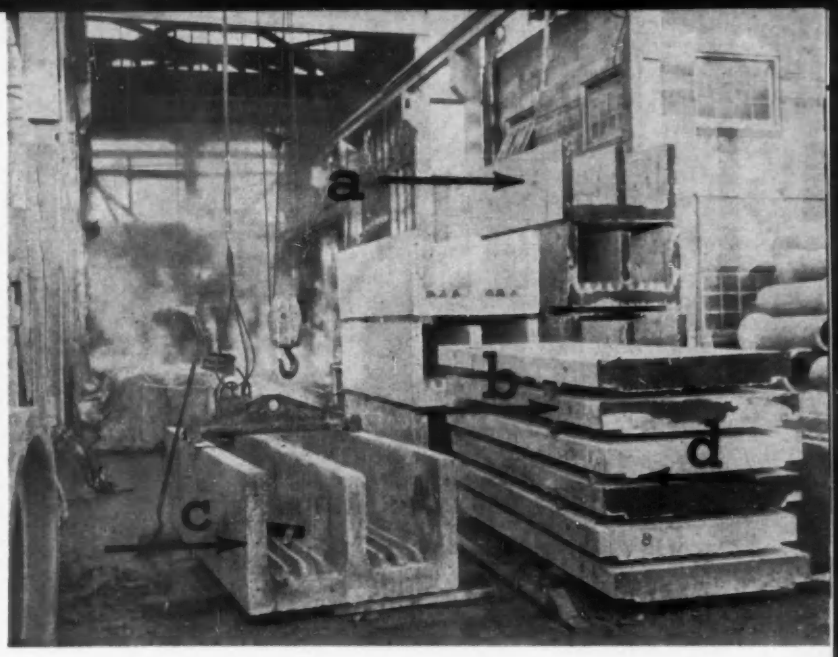


Metal parts of ladders, diving boards, and their supports, must be grounded.

Chapter 9 Tables

New Table 4A gives the allowable percentage fills of conductors used for rewiring existing concealed metal conduits.

Table 5 has been revised to include the dimensions of THW conductors (No. 14 to No. 8) and THWN (No. 14 to 500 MCM).



PRECAST SECTIONS of sidewalk wiring troughs are reinforced concrete. Each 8-ft unit, consisting of grooved base and slab cover, weighs approximately 5 tons. Note holes A and B for insertion of lifting tongs; holes C for alignment dowels. Stepped shoulders D prevent lateral shifting of covers.

Primaries Under Sidewalks

Unusual precast concrete troughs distribute primary power through Northwest community development. Buried conduits extend to customers' premises. Located parallel to streets and set flush with ground, continuous cover sections also serve as sidewalks. Prime contractor for entire primary installation was Industrial Electric, Seattle, Wash.

AN UNDERGROUND electrical distribution system of unique design is being installed in a community near Seattle, Wash. Wiring is laid in precast concrete troughs sunk in trenches. The trough covers form the sidewalks of the area. The novel installation provides the esthetic and maintenance advantages of a complete underground system while permitting ready and unlimited access to the system at any time by properly equipped and authorized utility crews.

Typical trough sections, made of reinforced concrete, measure 8-ft in length, 4-ft in width and 3-ft in depth, including a 7-in. thick cover. Weight of each cover is 3350 lbs; trough sections weigh approximately 3 tons each. Trough sections are partitioned lengthwise by a 4-in. wall down the center. Each half-section is grooved along the bottom to provide four separate troughs for holding single-conductor primary cables. In addition, metal plates, precast into side walls, are designed to accept brackets for the support of splices or additional cables. Cable space is ample to satisfy future power requirements in this mushrooming community development which is expected to reach a population of 350,000.

Trough cover slabs are constructed with stepped shoulders to prevent lateral shifting. Shoulders are keyed to the side walls of the trough sections to prevent longitudinal movement as well. Ends of abutting trough sections are fitted with premolded membranes. Mastic filler strips are placed between adjacent cover slabs. Trough sections are laid on a base of 4-in. gravel, tamped firm prior to installation. Special care was exercised in setting the troughs to assure exact sidewalk elevations.

At all low points in the trough and at least every 50 ft along level runs, 3-in. drain holes are provided. Expansion joints are spaced at intervals of 50 ft or less, depending upon local construction details.

Adherence to exact elevations is particularly important at street-crossing points, where trenches ter-

minate. In such instances, terminal sections slope downward at the bottom, going deeper to permit alignment with 6-in. steel conduits which run 5 ft beneath roadways. The conduits connect with continuing troughs on the other side of the roadway.

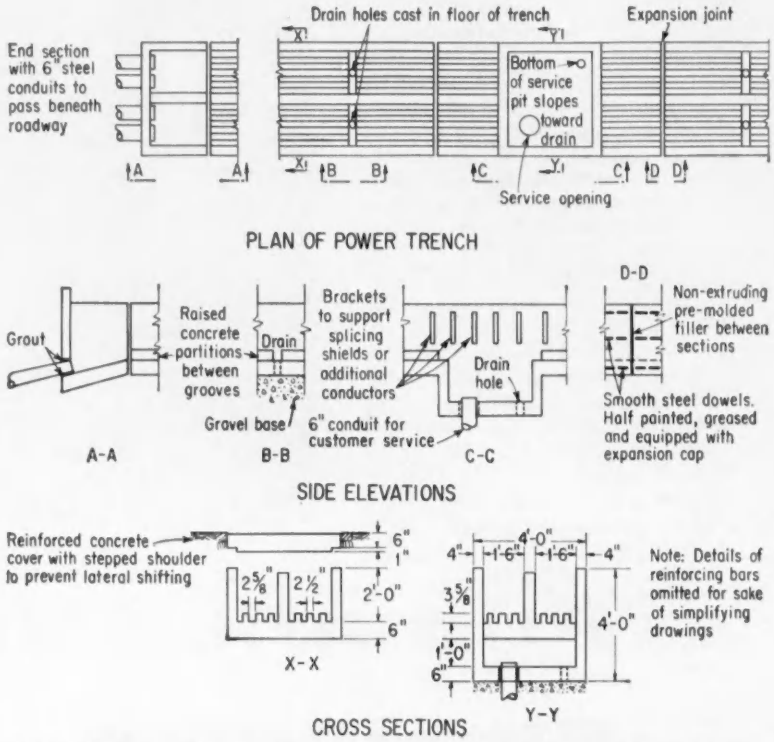
Special sections are inserted along the runs for customer-service connections. They consist of dropped bays, the floors of which are depressed 1½ ft lower than the trough floor. Six-in. distribution conduits are carried downward from the bay, then laterally to customer premises. Where service conduits pierce floors of dropped bays, ends are stubbed 1 in. above floor level, grouted in place and capped with insulating bushings. Each bay also is equipped with a ground rod and clamp from which a flexible braid conductor extends to each splicing shield located within the service cubicle.

As noted in an accompanying sketch, splice shields are T-shaped, with taps directed either downward or horizontally, depending upon whether the tap is to enter a customer's service conduit or connect laterally with an intersecting trench section. Rigid steel conduits are painted with bitumastic to inhibit corrosion. Concrete in precast trench sections has a 28-day compressive strength of 3000 lbs.

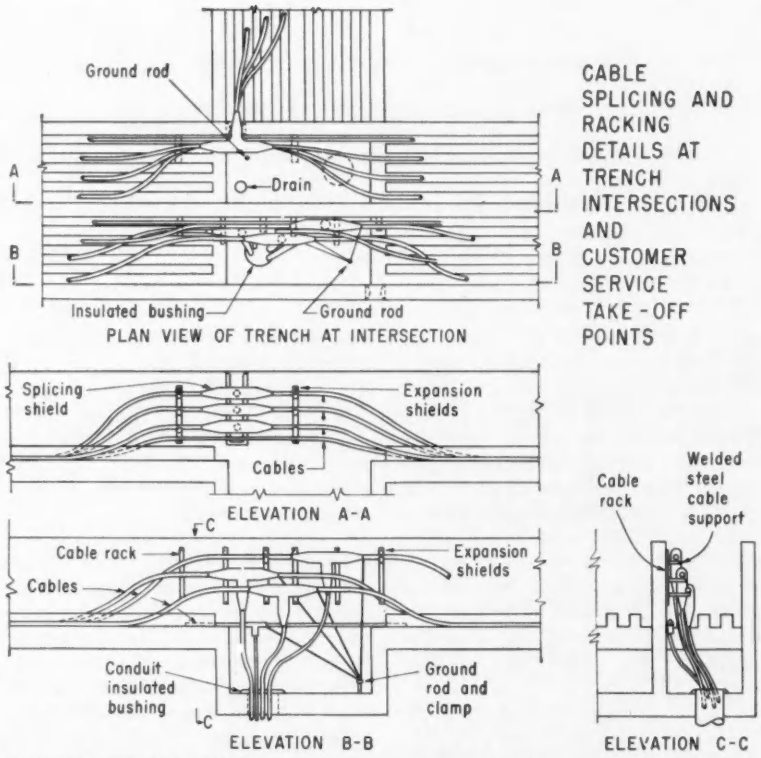
The underground distribution system connects with an overhead utility supply line through a galvanized steel conduit carried up the terminal pole to a height of 16 ft aboveground then through asbestos-cement duct upward to just below the terminal potheads, fuse cutouts and lightning arrestors. Cables are supported and sealed at the top of the duct. Conduits and neutral wires bond to a common ground.

This installation serves Overlake Park, located just east of Seattle. Conceived as a self-contained metropolitan satellite, foundations are being placed for a large number of homes, small industrial plants, research labs, retail stores, churches, a hospital, professional offices, schools and shopping centers.

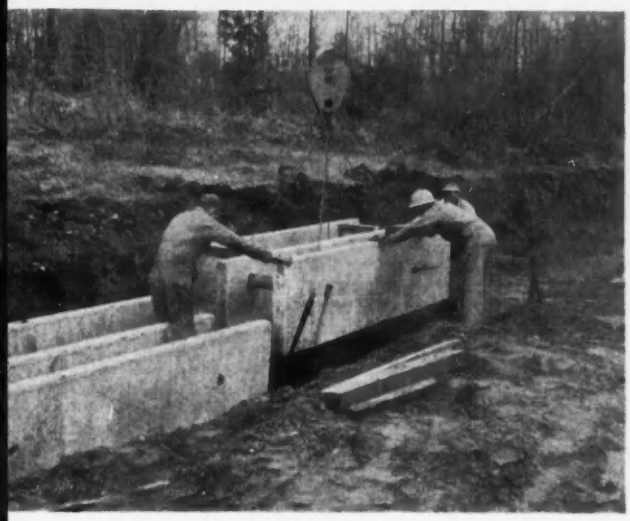
This idea of boxing primaries "under foot" in prefabricated cableways was developed by Puget Power & Light Co. engineers. The installation was assigned to the Industrial Electric Co., Seattle, Wash., under a prime-contract agreement.



DETAILED SKETCH shows features of standard trough and cover sections, customer service pits, sloping terminal sections, drains, expansion joints and grouted conduit connections.

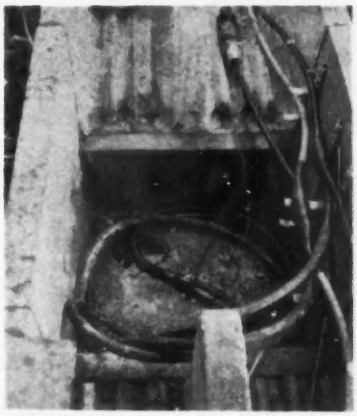


T-SHAPED SPLICING SHIELDS are mounted either vertically or horizontally, depending upon whether connections are for customer service or for connection to intersecting feeder. Note details of cable racks and welded steel supports on side walls, also position of ground rod, drain and bushed conduit in bottom of pit.

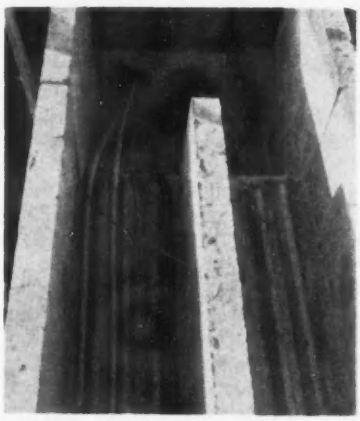


TAMPED GRAVEL BED of trench was accurately leveled to insure exact slab elevation atop completed distribution system. Steel dowels were then inserted into holes in abutting end-planes, premolded membranes were positioned, and sections were snugged into close contact.

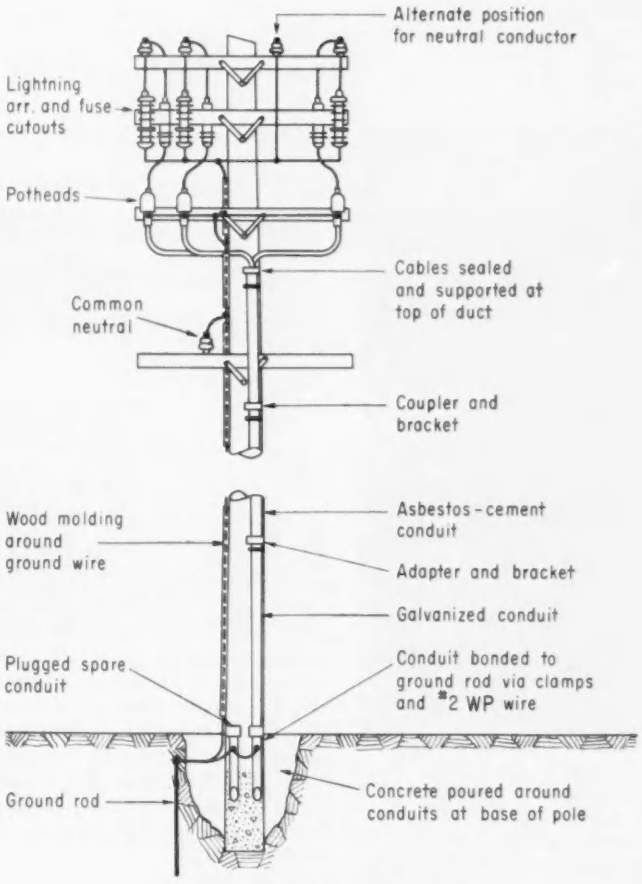
HEAVY COVERS, each weighing 3350 lbs, are lowered into position after cable-laying. Gaskets are placed between end surfaces before covers are snugged together. Note special sling arrangement attaching to rods inserted temporarily into slab, also stepped shoulders to prevent lateral shifting.



PRECAST PIT, for customer service connection, contains central ground rod for connection with splice sleeves, side brackets for support of primaries and T-taps.

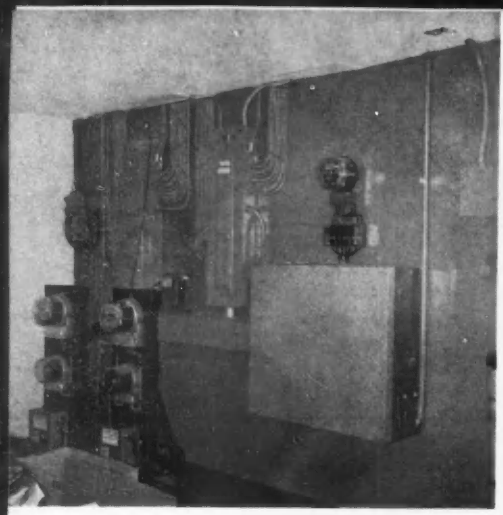


TROUGH STOPS at street intersections, with sloping terminal section carrying cables downward to 6-in. dia conduits that pass under roadway then reconnect with similar trough section on other side.



TERMINATION AT POLE.

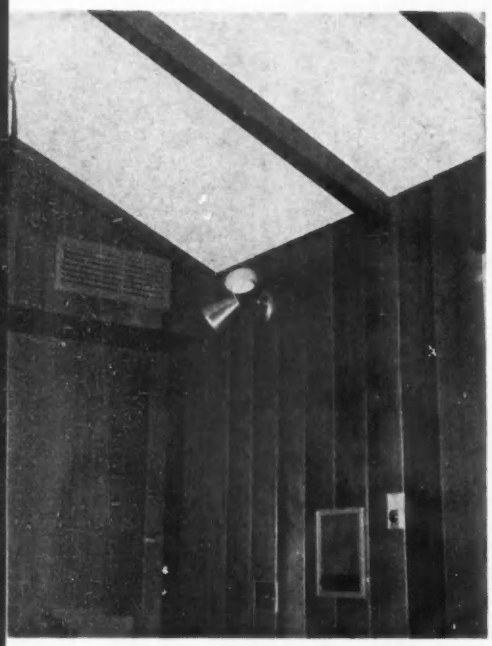
UTILITY line is tapped at terminal pole as shown. Connecting cables enter conduit drop sealed cable support then under roadway to connect with sidewalk power trough.



SERVICE EQUIPMENT for the residence is shown here. Service entrance conductors are run underground in conduit from an outside utility pole. A 3-in. conduit carries four 4/0 RHW-insulated conductors and one 4/0 bare copper conductor. Two insulated conductors are used in multiple for each hot leg of the 120/240, 3-wire, single-phase supply, and the bare conductor is used for the grounded neutral. The underground conduit feeds into the back of the large CT cabinet at right. SE conductors are then carried into the gutter shown from which tap conductors are run up to the 200-amp main CB in each of the two distribution panelboards shown. The panelboard at left supplies branch circuits for lighting and appliances in the house (including range top, double oven, clothes dryer, disposal unit, water heaters, kitchen receptacle outlets). The panel at right supplies circuits for all electric heating (space and driveway) and for air conditioning units. The metering setups at left are temporary installations made by the utility company to study the heating load. Panel assembly at far left controls operation of the lawn sprinkling system. Bare ground wire for system is run in thinwall from right side of CT cabinet up and over to street side of water meter.

All-electric utilization adds up to . . .

115-KW Load in Residence



CORNER OF DEN reveals number of facilities: sloped ceiling contains heating wire in plaster between beams; air conditioning outlet is at upper left; dual R-lamp lighting fixture with swivel housings affords variety of lighting effects in corner; lighting control switches and receptacle outlets are at bottom of photo; intercom and music system station, with controls, is mounted in wall; thermostat for ceiling space heating in this room is at right of intercom station.

No compromise was made in the electrification of this 3-bedroom, one-story home in New Jersey. And the owners attest to the highest order of living comfort and convenience, with operating cost running under the design estimated value.

By J. F. McPartland

A NEW residence in Clifton, N. J., boasts an unusually high level of electrical utilization. Here, a 400-amp, 120/240-volt, 3-wire, single-phase service feeds a connected load of 115 kw. The total load covers the full-scale of electrically operated comfort and convenience devices — electric space heating, water heating (including instant boiling water), driveway snow removal, cooking, air conditioning, laundry equipment, humidity control, wide variety of lighting, lawn sprinkling, intercom and music distribution and other appliances.

The house itself has a living room, dining room, kitchen, den, three bedrooms and an entrance hall on the first floor. The basement of the house contains a 2-car garage, a large recreation room, a laundry room and a utility room. The house was designed in all details—including electrical work—by M. Leonard Levine, architect, Passaic, N. J. He was retained by the owners of this distinctive residence to design and supervise construction and decoration of the house. The architect explained the advantages of all-electric living to the owners, and they gave him the "go-ahead" for a total job. The electric heating system and thermal insulation of the house was designed by the Electric Heat Co., Paterson, N. J.

Puzio Bros., electrical contract-

ors, Wallington, N. J., made the electrical service installation and wire loads and outlets other than the electrical heat. Colite of Clifton, N. J., installed the electric heat.

Electric space heating throughout both levels of the house is provided by plastic-insulated heating wire embedded in the ceilings. The approach was the same in each room. The heating wire was stapled to the ceiling rock lath, with the wire run back and forth on uniform spacing to form a complete heating grid pattern on the ceiling. The cable was then covered with plaster to form the finished ceiling.

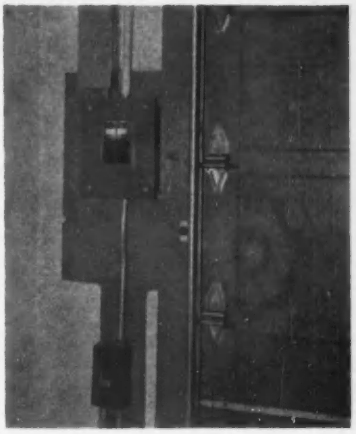
For each room, a heating calculation was made to determine the watts input required to match the heat loss characteristics of the room. Then a standard length of 240-volt heating wire with a "watts" rating at least equal to the required watts input was selected for the room. It was then a matter of uniformly distributing this length of wire in a ceiling grid pattern.

The standard pre-engineered lengths of heating wire come on spools with a length of non-heating cable spliced to each end of the heating wire to run from the ceiling down to the wall thermostat controlling operation of the heating wire. These non-heating power leads are single-conductor type UF cable for installation in stud space without the use of loom or raceway. This use of type UF is prohibited for general use by NEC Sec. 339-3 (d), which requires multiple conductor UF when used as non-metallic sheathed cable.

Each room is individually thermostatically controlled with armored cable used for all wiring from thermostats to the distribution panel. The line-voltage thermostats are mounted on inside walls.

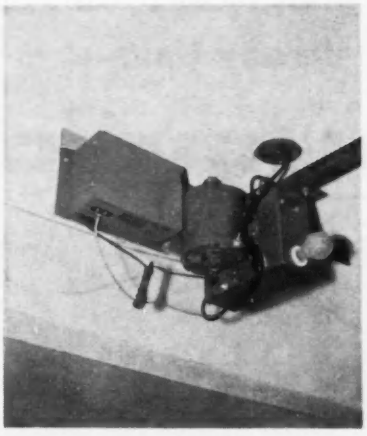
Thermal insulation is a carefully considered feature of this house. Cellulose fiber insulation was blown into the stud spaces of all outside walls, into the joist spaces above the first floor ceiling and into the joist spaces of the basement ceiling. Sidewalls were filled to the full 3⅝-in. depth of the 2 by 4 studs; 8 in. of insulation are in the first floor ceiling; and 8 in. of insulation are in the joist space above the basement ceiling. The insulation above the first floor ceiling serves the conventional func-

(Continued on page 114)



DRIVEWAY SNOW REMOVAL is accomplished by three heating wire lengths woven on chicken wire and embedded in a rectangular pattern to cover the 24 ft by 45 ft concrete driveway to the 2-car garage. A subfeeder from the heating distribution panel in the utility room is run to the sub-panel shown (at left) in the garage. One 40-amp, 2-pole CB in this panel protects a 220-volt circuit of two No. 8s feeding up in ¾-in EMT and over to a JB (photo at right) on the wall between garage doors, where the cold leads from two 4300-watt heating wire elements are connected to the circuit. A 20-amp 2-pole CB in the subpanel protects another circuit feeding down out of the panel to supply the third 4300-watt driveway heat wire. The enclosure shown below the panel (photo at left) and the two enclosures below the JB (in photo at right) house thermostats (one for each heat wire element) to open the heating circuits when the temperature at the interior of the concrete driveway reaches 80°. These thermostats operate automatically from sensing devices embedded in the concrete. Operation of the snow removal system is manually controlled by ON-OFF positioning of the panel CBs.

GARAGE THERMOSTAT on garage wall is pointed out by M. Leonard Levine, architect of the residence. Heating wire in ceiling heats the 2-car garage. The two walls of the garage which adjoin living areas in the basement are fully insulated for the depth of the stud space. The garage ceiling is also insulated. The two small pushbutton switches above the thermostat are low-voltage devices which provide manual control of the motorized garage-door operations. Two switches below the thermostat control ceiling lights in the garage.



DOOR OPERATOR for each overhead-lift garage door is a plug-connected, radio-controlled, motorized unit. Each door operates on its own radio frequency. Each of the two cars kept in the garage has its own transmitter which controls operation of the door operator for one side of the garage. When the operator opens the door, the light is turned on. When the operator closes the door, the light is turned off. This light on each door operator may be operated (with the motor) from the radio transmitter in the car or from the pushbuttons on the garage wall. These lights are used in conjunction with the standard ceiling lights in the garage to provide lighted access into and out of the garage.

MERCURY floodlighting provides a new dramatic lighting effect to the crown of the Ford Rotunda, automotive exhibit building in Dearborn, Mich. The new lighting system consists of 242 wide-angle floodlights, each using a 250-watt mercury vapor lamp.

Mercury Units

Improve Floodlighting Efficiency

New mercury floodlights on Ford Rotunda in Dearborn, Mich., provide 45 lumens per watt compared with six lumens per watt for old incandescent units which they replaced.

WIDE-ANGLE mercury lamp floodlights were installed on the Ford Motor Company's Rotunda exhibit building in Dearborn, Mich., in order to replace incandescent lamp floodlights which have been in use since 1953 to floodlight the exterior of this building. The mercury units were installed in order to obtain more efficient exterior lighting of the Rotunda, and to achieve a dramatic floodlighting effect more economically.

The former installation of incandescent floodlights consisted of 150-watt type A-25 inside frost standard lamp reflector units, mounted on a special angled wireway housing custom-made for the job, and spaced on approximately 10-in. centers. Each reflector was also equipped with a dense amber color lens. Light output of the 150-watt standard lamps when new is about 18 lumens per watt, or 2700 lumens per lamp. Considering the light loss in the reflectors, which were deteriorated to considerable extent, and in the amber lenses due to absorption, it was estimated that the over-all efficiency of the old instal-

lation was about six lumens per watt. Not only were the units inefficient, but the rated lamp life of these lamps is only 750 hours, and this contributes to costly maintenance and operating expense.

Taking these factors into consideration, company officials called in L. H. Beck, of the Detroit firm of L. H. Beck Electric Sales Co., for consultation. After study and analysis of the problem, with the cooperation of Carl Carlson of Graybar Electric Co. of Detroit, Beck estimated that mercury lighting could be installed to replace the incandescent system, and that savings of approximately $7,500 in the annual operating expense of the floodlighting system might be expected. The analysis is shown in the table "Cost Comparison Between Mercury and Incandescent."

Installation cost of the proposed new mercury lighting system, for the three tiers of the circular structure only, was listed as $17,434. Based on operating eight hours a day, the new system would pay for itself in 2 years, 4½ months, and save $615 monthly thereafter, according to the study. And if the system is operated 12 hours a day, the mercury installation would pay for itself in only 19 months, and provide a monthly savings of $930 thereafter.

The installation of the mercury floodlights was approved, and was made by mechanics of the power and utility services of the company, with L. H. Beck as consultant.

The complete installation as finally made consists of 192 mercury floodlight units installed in the central circular portion of the Rotunda, and 48 similar units installed to light the top part of adjacent wings. These units have a light output of 45 lumens per watt, and each unit replaces ten of the old incandescent units.

The old incandescent floodlighting was installed in 1953, and consisted of 2,330 150-watt units arranged in tiers, and along the upper part of the wings. The tiers were lighted by 1,920 units, and the wings by 510 units.

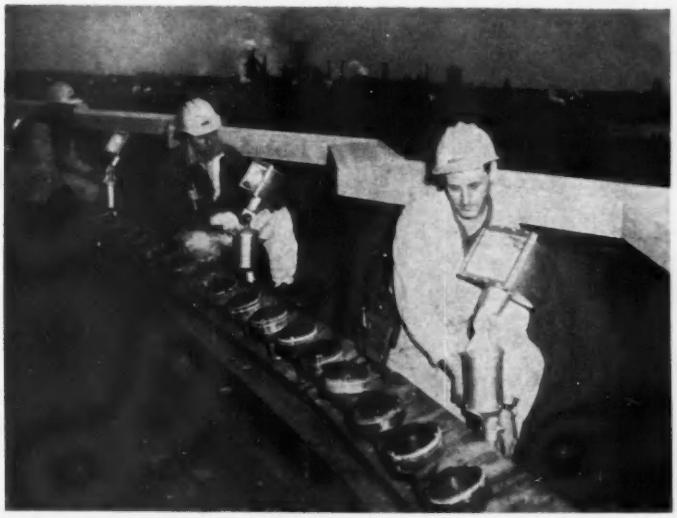
The Rotunda was originally an automotive exhibit building in the Chicago "Century of Progress" World's Fair, 1933-34. When the Fair closed, the Rotunda was dismantled and moved to Dearborn, where it was reconstructed as a permanent exhibit building. In 1953 a roof was constructed over the center court of the Rotunda, enclosing this area and providing more floor space for exhibits. The incandescent lighting system was also installed at that time. Now, after eight years of use, that system has been replaced by the new and more efficient mercury lamp installation. The Rotunda now shines with a new brilliance, of distinctive color, and at considerable savings in maintenance and operating costs.

FLOODLIGHTING OF FORD ROTUNDA, DEARBORN, MICH.

(Cost Comparison Between Mercury and Incandescent)

	MERCURY		INCANDESCENT	
No. of floodlights	192		1920	
Wattage/floodlight	267*		150	
Rated lamp life (hours)	12,000		750	
Total electrical load (watts)	51,264		288,000	
	8-hr/day	12-hr/day	8-hr/day	12-hr/day
Estimated use per year (hours)	2920	4380	2920	4380
Cost of Maintenance (4-year period)				
Number of relampings	1	1.45	15.5	23.4
Cost of labor (4-year period)				
Mercury @ $1/lamp	$192	$278	.....	.....
Incand. @ 50¢/amp	.....	.....	$14,880	$22,464
Cost of lamps (4-year period)				
Mercury @ $11.97	$2,298	$3,332	.....	.....
Incand. @ $0.205	.....	.....	$6,100	$9,210
Cost of Electric Power (4-year period)				
Power Consumed				
Kwh/year	149,691	224,536	840,960	1,261,440
Kwh/4-year period	598,764	898,144	3,363,840	5,045,760
Power cost (@ $0.004/kwh)	$2,395	$3,593	$13,455	$20,183
Total Maintenance and Power Cost (4-year period)				
Cost (Maint. & Power)	$4,885	$7,203	$34,435	$51,857
Total savings (Mer. Vs. Inc.)	.....	.....	$29,550	$44,654
Savings per month	.....	.....	$615	$930
Cost of mercury installation (Equipment plus labor)	$17,434			
Mercury installation will pay for itself . . .				
@ 8 hours use per day, in 2 years-4.5 months				
@ 12 hours use per day, in 1 year-7 months.				

* Lamp consumes 250 watts, ballast consumes 17 watts.



ELECTRICIANS make final adjustments of the new mercury lamp floodlights on top tier of the Rotunda. The mercury units each replace ten of the old 150-watt incandescent units, shown attached to the angled and curving wireway housing.

• *ESTIMATING FORUM—XXII*

Analyzing Reported Costs Of Proposed Projects

Part I—Preliminary Studies

By Ray Ashley, *Research and Consulting Engineer, Oak Park, Ill.*

STATEMENT:

An estimator must be able to readily appraise reported costs for new building construction. Given the estimated cost of the electrical work, he must be in a position to quickly supply approximate figures for the following:

1. Base Costs
2. Man-Hours Labor
3. Manpower Demands
4. Duration of Project
5. Time Required for Estimating the Work

Preparatory work will be studied in this article. Later, analyses of specific projects will be made. Preliminary studies and preparatory work not only pave the way for analyzing costs, but provide an education in cost distribution that should be common to all estimators.

QUESTIONS:

1. ***What materials are useful for the purpose of analyzing reported costs?***
2. ***Do experienced estimators have to rely on compiled tables and charts when analyzing reported costs?***

ANSWERS:

1. ***Useful materials include:***
   a. Reference tables prepared for the purpose.
   b. Studies prepared by others.
2. ***Estimators do not always have to rely on compiled tables and charts. From long experience, they learn the approximate division of costs and length of duration for various sizes and types of projects.***

DISCUSSION:

Before launching into the discussion, let's become acquainted with abbreviations used in the subsequent text and tables. These include:

DJC—Direct Job Costs
INS—Insurance
OH—Overhead
MH—Man-Hours
MLR—Material-Labor Ratio
MPR—Man-Power Requirements
MU—Markups
RET—Return (anticipated profit)

Compiled Tables

The handy reference table in Fig. 1 is designed to aid, with the help of established multipliers, in the rapid analysis of the estimated contract price or reported cost of a project. Col. 1 lists a number of project sizes based on contract price. Cols. 2 through 8 show recommended percentage markups for direct job costs, overhead, insurance and return applied to material and labor for the various sized projects. The overhead values in Cols. 3 and 6 are for reference only. They are modest but consistent with practice when the better projects are being estimated.

FIG. 1—Multipliers Applied to Contract Price

For Complete Installations with 60/40 MLR and $4.00 per hr. Labor Rate

CONTRACT PRICE (Dollars)	MARKUPS USED							MULTIPLIERS (Unit × Contract Price)				HOURS LABOR
	MATERIAL MU (%)			LABOR MARKUP (%)								
	DJC	OH*	RET.	DJC	OH*	INS.	RET.	Base Cost THE JOB	Base Cost MATERIAL	Base Cost LABOR	LABOR HOURS	
1	2	3	4	5	6	7	8	9	10	11	12	13
7,000	3	10	8	8	35	10	10	0.704	0.422	0.282	0.071	500
13,500	3	8	6	7	28	10	10	0.741	0.445	0.297	0.074	1,000
26,200	2	7	5	6	25	10	10	0.765	0.458	0.307	0.077	2,000
39,000	2	7	5	6	22	10	10	0.770	0.462	0.308	0.077	3,000
64,500	2	6	5	6	20	10	10	0.776	0.466	0.310	0.078	5,000
96,000	2	5	5	6	18	10	10	0.782	0.468	0.313	0.078	7,500
127,000	2	5	5	6	17	10	10	0.788	0.474	0.315	0.079	10,000
315,000	2	5	5	6	15	10	10	0.794	0.476	0.318	0.080	25,000
625,000	2	4	5	6	14	10	10	0.800	0.480	0.320	0.080	50,000
930,000	2	4	5	6	13	10	10	0.806	0.485	0.322	0.081	75,000

Abbreviations:
DJC—Direct Job Costs
INS.—Insurance
OH—Overhead
MLR—Material-Labor Ratio
MU—Markups
RET.—Return (Anticipated Profit)

*—Overhead values from "Electrical Contracting," McGraw-Hill Book Co.

The right half of the table (Cols. 9 through 12) lists the multipliers used to analyze projects on the basis of contract or reported price. By using these multipliers, the estimator can quickly determine the job base cost, material base cost, labor base cost, and even the labor hours (Col. 13). From the labor hours, he can easily determine the normal duration of the project.

Use of Multiplier

To illustrate the use of the multipliers in Fig. 1, let's analyze a project with a $39,000 contract price. Using the figures in Cols. 9 through 12, we have respectively:

Base Cost of the Job—0.77 × $39,000 = $30,030 (use $30,000)

Base Cost of Material—0.462 × $39,000 = $18,018 (use $18,000)

Base Cost of Labor—0.308 × $39,000 = $12,012 (use $12,000)

Total Labor Hours—0.077 × $39,000 = 3,003 (use 3,000 hours)

A word of caution to the novice estimator. The multipliers in Fig. 1 are to be used for the purpose of analyzing reported costs. *They are not to be used for estimating work.*

An error of 10% in the analysis of a proposed project is not so serious, but a 10% error in the estimated cost when figuring a job may be disastrous.

Developing the Multiplier

Fig. 2 shows the basic method used to develop the multipliers. Again, the $39,000 project is used as the example. Markups noted in the left half of Fig. 1 were applied to relevant cost items. The final result showed a contract price that was 130% of the base job cost.

(Continued on page 116)

FIG. 2—Developing Multipliers For Contract Price

($39,000 project, 60/40 MLR, using markups in Fig. 1)

Base Job Cost—100%

Division of Base Job Cost—Material 60%, Labor 40%

The Estimate:

		Material		Labor
Base Costs		60.00		40.00
Direct Job Costs	2%	1.20	6%	2.40
Complete Job Costs		61.20		42.40
Overhead	7%	4.28	22%	9.33
Insurance (10% of Base Labor)		.....		4.00
Contract Costs		65.48		55.73
Return	5%	3.27	10%	5.57
Est. Contract Price—Material		68.75		61.30
Est. Contract Price—Labor		61 30		
Est. Contract Price—The Job		130.05		

Multipliers:

Job Base Cost—1/130 = 0.770

Material Base Cost—60% of 0.770 = 0.462

Labor Base Cost—40% of 0.770 = 0.308

Labor Hours ($4.00 rate)—¼ × 0.308 = 0.077

ELECTRIC HEATING FORUM

Heating with Infrared

A detailed look at infrared comfort heating, including sources, fixtures, physiological factors, capacity requirements, methods of control, and markets. First of two parts.*

MAN'S dependence upon the sun as his only source of warmth was his first contact with infrared radiation. He learned he could dry animal skins, food, wood and pottery by exposure to direct sunlight. Later, he discovered fire, learning to control its intensity and duration to do the same tasks the sun did for him. In addition, this new source of radiation could cook foods, keep him warm at night, and be made available where and when it was needed.

The wood-burning stove began to supplement the fireplace in the nineteenth century, adding the principle of convected heat to that of radiation. Around the turn of the century, electric wiring in homes, factories and offices encouraged the development of portable electric heaters using incandescent lamps or resistance wire backed by a suitable reflector to direct the radiated heat in the desired direction. This direction capability, coupled with the fact that infrared radiation warms only the objects which intercept it and not the intervening air, has led to its extensive use for what is variously described as *people*, *comfort*, or *spot* heating.

Infrared Sources

Today, much-improved electrical sources of infrared energy are available. These include two types of lamps and various devices employing resistance wire elements. Each of these suits certain applications better than the others. Knowledge of their characteristics will facilitate selection.

Infrared Lamps: Two basic lamp types predominate for comfort heating: the tubular quartz T-3 (¾-in. dia) lamp, and the glass, reflectorized R-40 (5-in. dia) lamp. Both types have tungsten filaments designed for 4000F operation at rated voltage, making them radiators of the so-called "near" infrared energy. The term *near* is used to indicate the relative position of the lamp's infrared radiation with respect to the visible spectrum. About 5% of the radiated output from infrared lamps is visible light —roughly ¼ that of lamps used for lighting. For outdoor and indoor comfort heating applications the additional illumination provided by heat lamps is often welcomed, particularly since it comes at no additional cost. Both lamps offer instant radiant heat, reaching full operating temperature in less than a second. Popularity of the R-40 lamp with built-in reflector is due to the ease of installation—all that is needed is a porcelain screw socket. About the home, for example, R-40 heat lamps are found in garages, work shops, bathrooms, porches and recreation rooms.

The long, slender T-3 lamp in the sealed translucent quartz tube is effective for medium or high mounting heights or where high wattage densities are required, since it is loaded at 100 watts per in. of filament length. The T-3 lamp does not include a reflector as does the R-40; therefore special equipment has been designed to direct its radiation.

Resistance Heaters: Sources having resistance wire elements include those using a simple straight or coiled wire mounted on ceramic insulators, and those using heating wire confined within quartz, silica quartz, or metal tubing or metal castings.

Quartz tubes, which are closed but not sealed off from the atmosphere, are available in tubing diameters from ¾ to 1 in. Although they have the same general appearance as the quartz lamps described above, there is considerable difference between the two. Because the hot wire cannot be sealed off from the atmosphere, a loading of 40 watts per in. of element length is the practical limit for quartz tubes of ¾-in. diameter, restricting the operating temperature to about 1900F. They glow at an orange-red color and have a heat-up time of about two minutes.

Heat-transfer theory and actual measurements indicate that the radiated energy component of such lower-temperature sources is approximately 64% of the input wattage, as compared with the 86% radiated by the quartz lamp. This may or may not be significant in actual application, since housing and reflector design, mounting details, and air movement all affect the amount of radiation actually reaching the person or persons to be heated.

Metal sheath heaters are used in convection and radiation type heaters. They offer the maximum in ruggedness and as a result are frequently used in several kinds of commercial and industrial portable heaters. Sometimes the heaters are mounted on dollies to permit easy movement into service when needed. Metal sheath equipment is often used for spot heating applications where it is positioned at less than head height and sometimes on the floor.

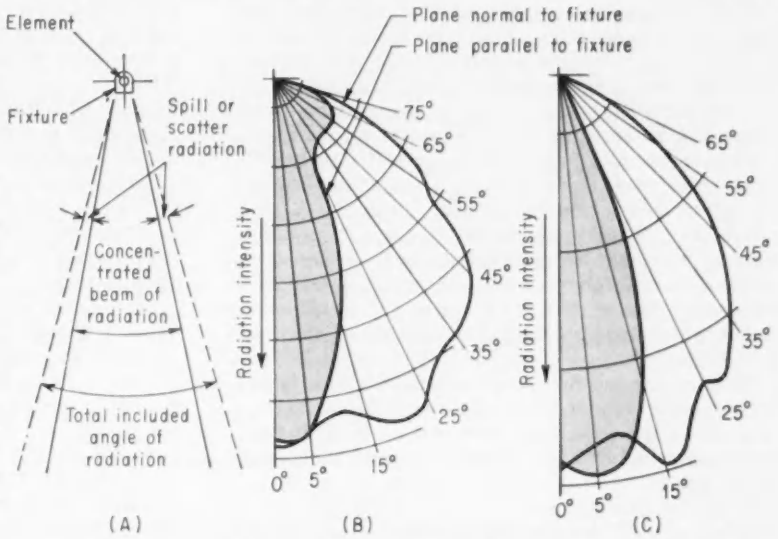
* Adapted from papers presented at NEMA's Second Electric Comfort Heating Exposition & Symposium in Chicago, March, 1962, by R. L. Boyd, Edwin L. Wiegand Co.; W. R. Stephens, General Electric Co.; and W. J. Novak, EI C & M.

FIG. 1. Fixture Radiation Patterns

(A) Fixture configuration will direct most of the radiation downward in a concentrated beam, although some "spill" or "scatter" radiation will be in evidence outside this beam.

(B) Radiation pattern of typical shallow fixture shows a concentrated angle of about 50° (25° on each side of center line), with spill increasing the total angle of radiation to about 150°. These angles are based on intensity measurements made in a plane normal to the fixture.

(C) Special fixture design almost eliminates spill, decreasing the concentrated angle to 45° and the total angle to 53°. The irregularities of both patterns in plane parallel to lamp are probably due to spacers supporting the element. The slight dip in intensity immediately below the fixture is due to the element itself interfering with reflected radiation.



These heaters require several minutes to reach operating temperatures. Normally designed for approximately 50 watts per in. in a ⅜-in.-dia tube, operation is over the range of 1200F to 1800F. Their appearance when up to temperature is also an orange-red.

Except for the metal sheath heater, which may be operated in any position, these tubular heaters are generally restricted to horizontal operation. The quartz lamp may be obtained on special order with specially designed filament supports for vertical mounting where the application demands it.

Infrared Fixtures

Generally speaking, infrared lamps and fixtures permit reasonably good control of the radiant energy; it may be aimed to those target areas where it is needed. The R-40 lamp has a desirable symmetrical beam pattern and presents little difficulty. The long, slender, straight shape of the quartz lamps, quartz tubes and metal sheath heaters makes lengthwise control difficult, although sharp reflector control in the crosswise direction is readily achieved.

Such tubular elements are frequently applied in shallow fixtures with concentrated beams of radiation between 30 and 90 angular degrees (Fig. 1A) but with spill or scatter radiation typically extending on each side of the concentrated beam so that the total included angle of radiation is from 150 to 160 degrees.

Fig. 1B is a graphical presentation of the distribution curves of energy from such a fixture measured on two planes: the plane normal to the lamp and the plane parallel to the lamp. Note that the greatest intensity of radiation is experienced between 0 and 30 deg from the vertical, giving a concentrated angle of 60 deg. Spill or scatter radiation extends the angle of radiation some 45 deg beyond the concentrated beam, giving a total angle of about 150 degrees.

The spill or scatter radiation is usually beneficial for close mounting (10 ft or less from fixture to target), particularly for comfort applications. At these closer distances, it is not desirable to have the sharp cut-off in radiation as one moves from the specific pattern provided. The spill or scatter radiation tempers the vicinity of the more concentrated radiation and avoids the sensation of moving abruptly from the heated to the unheated area. However, for mounting distances greater than 12 ft between fixture and target, the spill or scatter is a disadvantage, since most of this portion of the radiation usually strikes above the working level and is essentially lost. The typical over-all delivery efficiency of such a fixture is 75 to 80% of the energy input delivered as visible light and infrared energy in the pattern shown.

Deeper fixtures permit more narrow beams with a concentrated angle from 30 to 60 deg and spill or scatter of only 5 to 10 deg more (Fig. 1C). Such fixtures are beneficial for distant mounting (12 to 50 ft) since more of the radiation produced is directed into the desired pattern. The narrow beam permits coverage of the same area from a greater distance, or provides a greater concentration in a smaller area from the same distance. The typical over-all efficiency of delivery of the deeper fixtures is 65 to 75% of the input energy delivered. Use of the wrong fixture type can thus negate any advantage in radiation efficiency gained through choice of element.

Physiological Factors

Application of these infrared sources to comfort heating requires some knowledge of the thermal interchanges between man and his environment. The average man seated and at rest dissipates roughly 400 Btu per hr, which is about 120 watts. The breakdown of this energy shows he loses about 25% of this total through evaporation, and the balance by

skin convection and radiation. These percentages can vary widely with environmental changes, as can the body heat output, depending upon the degree of activity. For example, walking at 2 mph increases body heat to about 800 Btuh. Under conditions of high ambient temperatures in still air, loss of heat from the body is predominantly by the process of evaporation. Heat production during maximum exertion can be 20 times as great as during sleep.

These principles suggest that comfort may be provided at different levels of room temperature, depending upon the degree of activity involved. A very active factory employee can be comfortable in a 55F ambient temperature, whereas the seated office clerk prefers 70F. In either case, discomfort in the form of perspiration or chill can result if the temperature is not maintained within a few degrees of the comfort value.

Body heat losses by convection and evaporation are rather easily understood. Both are dependent on average skin temperature, air temperature, and air movement; and evaporation involves relative humidity in addition.

Radiation loss is more complex, partly because it involves the *mean radiant temperature*. All objects, whether they be people, animals, machine tools or buildings, radiate energy to their surroundings. The amount of radiation given off and received is governed by the temperature and area of the object surfaces and also upon their ability to interchange energy. Theoretically, after sufficient time for radiation, absorption, re-radiation and reflection, all objects should reach a stable temperature condition. In actuality, changing weather conditions prevent it.

Under normal, comfortable environmental conditions the temperature of man's exposed skin and clothing is 83F. Since that is above the temperature of the objects about him, he radiates heat to the ceiling, walls, floor and such items of furniture or machinery that might be in the space. It is true that these objects are also directing radiation at the man, but because they are usually at a lower temperature, his body loses more energy than it gains. One object—say a lighted fireplace—will supply radiation to a man, while the cooler room surfaces will accept radiated heat from both the man and the fireplace.

A person seated on a stool with his back close to a large picture window during cold weather provides an example of how radiation can produce discomfort. He will soon have the sensation of heat being "siphoned" away from the back of his head and neck, and possibly his shoulders and back. His front side is not chilled because it is not exposed to or "seen" by the cold window.

Comfort can be restored in several ways: the persons can move to the other side of the room, draw the drapes, put on an overcoat, muffler and hat, or substitute a high-backed chair for the stool. All these remedies subdue the effect of the cold window, but actually the problem was relieved in just two ways—by improved room radiation geometry, or by use of radiation screens or insulation.

The foregoing makes clearer the meaning of mean radiant temperature. It may be described as the hypothetical uniform temperature of all surface areas surrounding a man at a specific location which would produce the same exchange of radiant heat between the man and his surroundings as does the actual existing room. The concept suggests the *idea* of a uniformly heated sphere with a person at its center.

A formula established by Raber and Hutchinson, two well-known authorities in the field of radiant heating, relates air temperature and mean radiant temperature under comfort conditions:

$$T_{air} + T_{MRT} = 140$$

The equation indicates, for example, that equal comfort can be maintained in a 60F air temperature with an 80F mean radiant temperature or vice versa.

Mean radiant temperatures *higher* than air temperatures represent a new concept. Inherent in prevalent convection-type, centralized warm air heating systems are air temperatures warmer than wall temperatures.

How can a condition be created where the mean radiant temperature exceeds the air temperature? It could be accomplished by a number of fireplaces located around the room. Another approach would be low-temperature heating cable buried in all the room surfaces. The *new* approach is installation of infrared comfort heating equipment on the ceiling in much the same way that lighting fixtures are mounted. Such heating equipment will increase the mean radiant temperature of the overhead area. In addition, the radiation projected downward will warm the floor, machinery, people and lower wall areas intercepting it, thus raising the mean radiant temperature throughout the space. The air will be heated too, but indirectly by convection as it moves over the warm floor and other objects.

With this different method of over-all room heating not only can the body radiation loss be reduced; the body can also gain heat by radiation incident to the skin and clothing. The warming effect of the direct energy received by a person has the effect of reducing the mean radiant temperature needed for comfort at a given air temperature.

This is an important concept. The use of infrared energy aimed directly at a target area makes it possible to provide much-improved comfort to persons working in outdoor or semi-outdoor environments. Furthermore, this direct heating technique permits "spot" or "zone" heating of small areas in otherwise unheated buildings.

Capacity Requirements

For comfort heating, radiation should be applied from at least two directions, neither directly overhead, with adequate radiation of the lower extremities as well as the head and shoulders. It is obvious that only a small portion of the approximately 19½ sq ft of exposed area on the average clothed body would be radiated by a fixture directly overhead. The top of the head and shoulders represent a very small area, and the balance of the body is substantially all in the shade. Moving off to the side with one element radiates much more nearly half of the available surface area, while radiating from two opposite directions covers substantially all of the area. However, even better results can be secured by radiating from all four sides, or even from three where all four are impractical. Since the heaters are usually located overhead, the head and shoulders are usually much closer to the heaters than the central parts of the body and the lower extremities. The phrase "Hot heads and cold feet make unhappy workers" can be a

reminder that attention needs to be paid to radiating all parts of the body, and because of the generally closer proximity of head and shoulders to the fixtures, the floor around the subject would ideally be well radiated to add its influence to warming the central and lower parts of the body.

The outside design temperature is significant only so far as it influences the lowest inside temperature which the infrared is intended to overcome. Infrared is not an air heater. Only a small fraction of the infrared energy passing through air is absorbed by carbon dioxide, water vapor, dust, etc., so that air is warmed only slightly by the passage of infrared energy through the air. The function of infrared is to produce relative comfort despite a lower than normally comfortable ambient temperature. The floors of large areas do not become nearly so cold as minimum outdoor temperatures and in most areas seldom if ever get below freezing, even in unheated buildings. Outside design temperature is not significant in infrared design. The real design factors are the lowest ambient in which the system is to be called upon to provide relative comfort and the wind or draft conditions under which such relative comfort is to be provided.

Many infrared installations heat specific work stations without attempting to raise the temperature of the ambient air, and without particular regard for the heat loss of the structure itself. Indeed, these work stations may be without an enclosing structure. However, there are also complete heating applications where infrared units may be used with advantage. These usually involve the heating of a distributed group of people in an enclosure having a relatively large floor area and a high ceiling, where attempting to effect heat transfer by heating the air would be impractical and prohibitively costly.

For such total building or large-area heating, a variety of methods of arriving at capacity requirements are in current use. They range in value from ¼ to ¾ watts per sq ft per degree rise in comfort level desired, depending primarily on the building construction and insulation involved.

Indoor spot heating similarly finds a variety of methods for arriving at the requirements with values generally about 1 to 1½ watts per sq ft for each degree rise in comfort level desired.

For windy conditions (inside or out), design attention to shielding from wind appears more fruitful than building up radiation. Winds of one to three miles per hour increase the required radiation for relative comfort quite materially over that required for still air. For winds of over ten miles per hour, it is questionable whether comfort can be attained with practical radiation densities in ambients lower than 40F. Outdoor applications find real benefit from infrared in mild weather and moderate wind (under ten miles per hour) and for cold weather and little wind (under two miles per hour) but little or no benefit—even after a minimum of 15 to 20 minutes exposure to radiation, in cold windy weather. It is most important that the customer and all others involved are aware of the lowest ambient temperature and accompanying wind or draft conditions under which the system is *expected* to produce comfort.

For complete space heating, infrared heaters are mounted with overlapping heat patterns to cover the entire floor area. Heat is radiated to the floor, occupants, machinery, etc., all of which re-radiate heat to other surfaces which are at lower temperatures. Secondary convection currents transfer some of the heat to the air; however, comfort conditions will be achieved at lower air temperatures than exist with normal convection heating systems. Thus considerable energy is saved in large-volume, high-ceiling spaces since the air need not be heated directly. In such a system, thermal insulation can play an important part in improving comfort and reducing operating costs.

Conventional heat-loss calculations may be made to arrive at the required installed capacity; however, indoor design temperatures may be chosen as low as 50F, depending upon the activity involved. Some extra capacity is usually provided by inclusion of a factor to account for the effect of room configuration on re-radiation from wall and floor surfaces, similar to the use of the room-ratio factor in lighting calculations. In addition, unless the fixtures used provide a well defined concentrated beam of radiation, the spill radiation at greater mounting heights may be relatively ineffective and necessitate the inclusion of extra capacity to account for the mounting height. It is also true that less capacity will be required if a period of preheating is possible before the occupants enter the space, since all surfaces and objects in the room will have had time to absorb radiation. Thus both the mean radiant temperature and air temperature will be greater when the space is finally occupied, inducing greater initial comfort with less direct radiation. Some experience indicates that the installed capacity may be reduced to about 70% calculated value if ½-hr preheating is possible, and to about 50% with 1 hr preheating, where the outside design temperature is 30F and the inside air temperature is 60F.

The heater capacity required for comfort in spot-heating applications depends upon a great many variables. One kilowatt input to an infrared heater will not result in one kilowatt of heat being radiated to the individual to be heated. Involved are such factors as the initial efficiency of the element in converting electrical energy to radiant energy; the amount of the resultant energy which is dissipated by wind or drafts before it can be radiated; how much of what's left will actually impinge on the body of the individual to be heated; the amount of the impinging radiation which is actually absorbed; the extent to which wind or drafts nullify this absorbed radiation; and finally the effect of secondary convection and re-radiation on over-all comfort.

Research indicates that the radiated heat required to be received by the human body for comfort increases from about 60 watts to 350 watts as the mean radiant temperature decreases from 65F to 40F, assuming that there is no wind involved, and that heat is received uniformly and perpendicularly to all body surfaces.

Since low-cost, accurate instruments are not available to measure either the mean radiant temperature or the radiation received by a body, design of spot-heating applications is approached through the input energy to the lamps, using manufacturers' information on the fixture angle of radiation and the element's efficiency of radiation coupled with correct positioning and mounting height of the fixtures to effectively cover the target area.

LUBRICATION FREQUENCY TABLE

Type of Bearing	Motor Size Where Normally Applied	Lubrication* Frequency
Sleeve		
Plain sleeve	Fractional hp	6 mo to 1 yr
Oil-ring sleeve	Large	6 mo to 1 yr
Ball bearing		
Open	Large	3 mo to 3 yr
Single shield	All sizes	3 mo to 7 yr
Double shield	All sizes	6 mo to 7 yr
Sealed	Medium & small	Not needed**

* Recommended lubrication frequency depends on type of service—easy, standard, severe, or very severe. Use the longest interval on easy applications; use the shortest interval on very severe applications.

**Sealed bearings may be disassembled and repacked with grease at 1 to 5-year intervals depending on kind of service.

Effective Motor

Here's how a plant electrical department applies modern bearing maintenance techniques to increase the life of motors.

AT THE Weston Instruments Division, Daystrom Inc., Newark, N. J., motors last longer and perform better because plant electricians follow a carefully planned motor lubrication schedule and apply the latest bearing maintenance techniques.

Previously, ac motor failures accounted for a high percentage of electrical repair work. And most of these failures were traced to faulty bearings. As a result, their motor maintenance program places heavy emphasis on proper handling, repair and maintenance of various types of sleeve and ball bearings.

Motors of various types and sizes are used extensively in all processes at the plant, which consists of nine major buildings encompassing 500,000 sq ft. The plant produces a wide range of high-quality electrical measuring instruments as well as instrument component parts. Major processes include plastic molding, small-parts machining, assembly and testing.

In the following personal interview, Howard Wachter, chief electrician, describes his electrical maintenance procedures and discusses modern bearing maintenance techniques.

How is your electrical department organized?

The electrical department is part of the maintenance division, which is supervised by the plant engineer. Headed by a chief electrician, the electrical department consists of eight electricians, who perform electrical preventive maintenance as well as emergency breakdown repairs.

The chief electrician plans electrical preventive maintenance, supervises the electrical crew, formulates electrical maintenance and repair procedures, selects spare electrical parts, and advises on selection of new electrical equipment.

How is your EPM (electrical preventive maintenance) program set up?

We do not go overboard on preventive maintenance. Because we are essentially an assembly plant and because our products are, in a sense, handmade or custom-made, our processes do not include a high-production continuous type of operation. Related to electrical maintenance, this means that downtime will not hurt us nearly as much as it hurts an automated high-production process. Therefore, we feel it is more efficient to function with a minimum-size electrical crew and perform electrical maintenance on only essential or expensive equipment or where it is needed.

However, since motor failures

Seventh in a series of articles on current industrial electrical maintenance. Previous studies were: (1) Effective Large Plant Maintenance, April, 1961; (2) Effective Small Plant Maintenance, June, 1961; (3) Electrical Maintenance by Contract, August, 1961; (4) Effective Maintenance Starts at the Top, October, 1961; (5) New Plant Start-Up, January, 1962; (6) Tools and Techniques for Effective Maintenance, March, 1962. This series covers operating procedures and work methods in typical industrial plants through personal interviews with key plant personnel.

BALL BEARING is assembled into cartridge-type housing. Bearing must be seated squarely on shaft and must fit snugly. Before installing on shaft, bearing should be heated either by an induction heating unit, or by immersing it in oil that has been heated to a temperature of about 200°F.

VERTICAL INSERTION aids in centering motor shaft to housing when extreme clearances occur. The bearing should be free to move axially to allow for shaft expansion. If the fit is too loose, however, the housing will be damaged. During all assembly phases, strict cleanliness must be maintained.

PLAIN SLEEVE BEARING receives a coating of a durable plastic sealant, which acts as a shim, filling excess clearance between bearing and housing. After the application, the assembly is set aside for two to four hours to allow the sealant to harden into a strong and long-wearing surface.

Bearing Maintenance

were our most frequent cause of downtime, we felt that preventive maintenance or other necessary steps to reduce motor failures would be worthwhile. Therefore, we investigated these motor breakdowns and, as a result, we established a modern motor repair and maintenance program.

How was your motor maintenance program established?

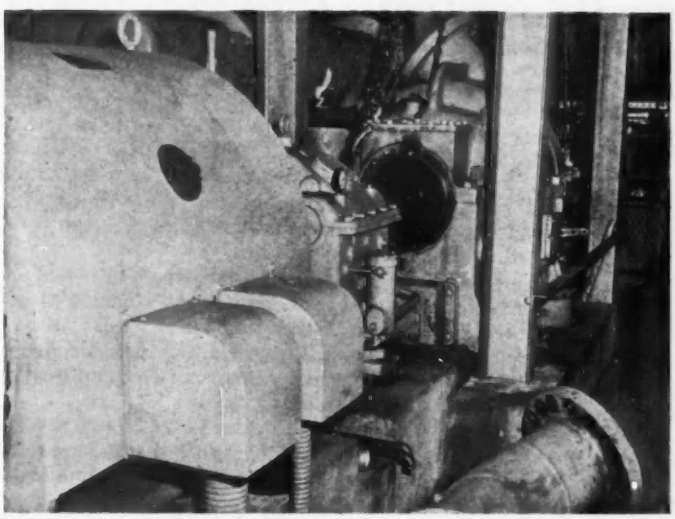
The first step was to find out why our ac motors were failing. And, of course, there are various causes of motor breakdowns, such as excessive load, binding or misalignment of motor drives, wet or dirty surroundings and bearing failures. Among these we found that faulty motor bearings were the most common cause of failure. And it is significant that such failures occurred in newer motors with high-quality bearings as frequently as in older motors equipped with less reliable bearings. A notable exception was that motors equipped with sealed bearings were much less prone to failure.

Considering this data, particularly the fact that sealed bearings are shielded from contamination and do not require lubrication, we concluded that contamination of bearings was one of the major causes of bearing failures.

As a result, we updated our motor lubrication methods and bearing maintenance techniques, emphasizing cleanliness in procedures for all types of motor bearings.

What types of bearings must you maintain?

There are many types of bearings, however, most of our motors are equipped with ball bearings. Ball bearings may be found on various-size motors and their construction may be (1) open, (2) single shielded, (3) double shielded, (4) sealed, plus double row and other special types. Open bearings are of open construction and must be installed in a sealed housing. These bearings are less apt to cause churning of grease, hence they are usually applied only on large motors.



BEARING MAINTENANCE includes overhaul and inspection of large oil-ring sleeve bearings. At left of photo, a 4160-volt, 250-hp wound-rotor motor drives a refrigerant compressor via a speed converter. Exposed coupling at the compressor will be checked for alignment.

ELECTRONIC CODED-PAGING system incorporates an encoder, transmitter and several small, pocket size receivers which are worn by maintenance foreman. Maintenance secretary can dial a foreman's code on encoder, operate a switch and thus immediately contact the foreman anywhere in or near the plant.

POCKET-SIZE RECEIVER is worn at the belt by chief electrician, Howard Wachter. Upon receiving the proper signal from the transmitter, the receiver emits a series of "beeps" that correspond to Mr. Wachter's code. He then calls in to receive his message. The electronic paging system has proved to be an efficient time-saver.

The single-shielded bearing has a shield on one side to preclude grease from the motor windings. Double-shielded bearings have a shield on both sides of the bearing. This type of bearing is less susceptible to contamination and, because of its design, reduces the possibility of overgreasing. Sealed bearings have, on each side of the bearing, double shields which form an excellent seal. This bearing requires no maintenance, affords protection from contamination at all times, and does not require regreasing. It is usually used on small or medium-size motors.

Our very large motors are furnished with oil-ring sleeve bearings. And some of our fractional-hp motors are equipped with plain sleeve bearings.

How often do you lubricate motor bearings?

Frequency of motor lubrication depends not only on the type of bearing but also on the motor application.

Small and medium-size motors equipped with ball bearings (except sealed bearings) are greased every three to six years if the motor duty is normal. On severe applications (high temperature, wet or dirty location, or corrosive atmosphere), lubrication may be required more often. In severe applications, past experience and condition of the grease are the best guides as to frequency of lubrication.

We change lubrication oil in sleeve bearings at least once a year. When the motor duty is severe or the oil appears dirty, we change it sooner.

Describe your motor lubrication procedure.

For effective motor lubrication, cleanliness and use of the proper lubricant are of paramount importance.

When greasing a ball-bearing motor, the bearing housing, grease gun and fittings are wiped clean. Great care must be taken to keep dirt out of the bearing when greasing. Next, the relief plug is removed from the bottom of the bearing housing. This is done to prevent excessive pressure from building up inside the bearing housing during greasing. Grease is then added, with the motor running if possible, until it begins to flow from the relief hole. Allow the motor to run from 5 to 10 minutes to expell excess grease. Then the relief plug is replaced and the bearing housing is cleaned.

It is important to avoid overgreasing. When too much grease is forced into a bearing, a churning of the lubricant occurs, resulting in high temperature and eventual bearing failure.

On motors that do not have a relief hole, we apply grease sparingly. If possible we disassemble the motor and repack the bearing housing with the proper amount of grease. During this procedure we always maintain strict cleanliness.

The importance of strict adherence to these procedures cannot be overemphasized. We feel that *contamination* and *overgreasing* of bearings are the major causes of bearing failures.

For sleeve bearings, we use only the recommended oil for particular service conditions. Observing careful cleanliness, old oil is removed and new oil is added until the oil level reaches the "full" line on the oil sight gauge. This is done only when the motor is not running.

How do you test or check the condition of bearings on motors in place?

We find that the two most effective tests are what you might call the "feel" test and the "sound" test. The "feel" test is performed by the electrician. If, while the motor is running, the bearing housing feels overly hot to touch, it is probably malfunctioning. (Some bearings, however, may operate safely up to about 85° C.)

During the "sound" test, the electrician listens for foreign noises coming from the motor. Also, he may place one end of steel rod—3 ft long and about ½ in. in diameter—on the bearing housing; the other end is held against his ear. The rod then acts as an amplifier, transmitting unusual sounds such as thumping or grinding, which would indicate a failing bearing. Special listening devices, such as the transistorized stethoscope, can also be used for this purpose.

Additional checks can be made. For example, the air gap on sleeve-bearing motors should be checked periodically. These tests, performed with a feeler gauge, indicate when a bearing begins to wear. Four measurements are taken about 90 degrees apart around the rotor periphery. These measurements are recorded and compared with earlier readings, providing a check on condition of the bearing.

Motors should also be checked for end play. Ball-bearing motors should have about $\frac{1}{32}$ in. to $\frac{1}{16}$ in. end play. Sleeve-bearing motors may have up to ½ in. end play.

On large sleeve bearings the oil level is checked periodically, and the oil is visually inspected for contamination. If it is possible, the electrician checks that the oil rings rotate when the motor is operating.

Other inspections include checking for misaligned or bent shafts and for excessive belt pressure.

(Continued on page 170)

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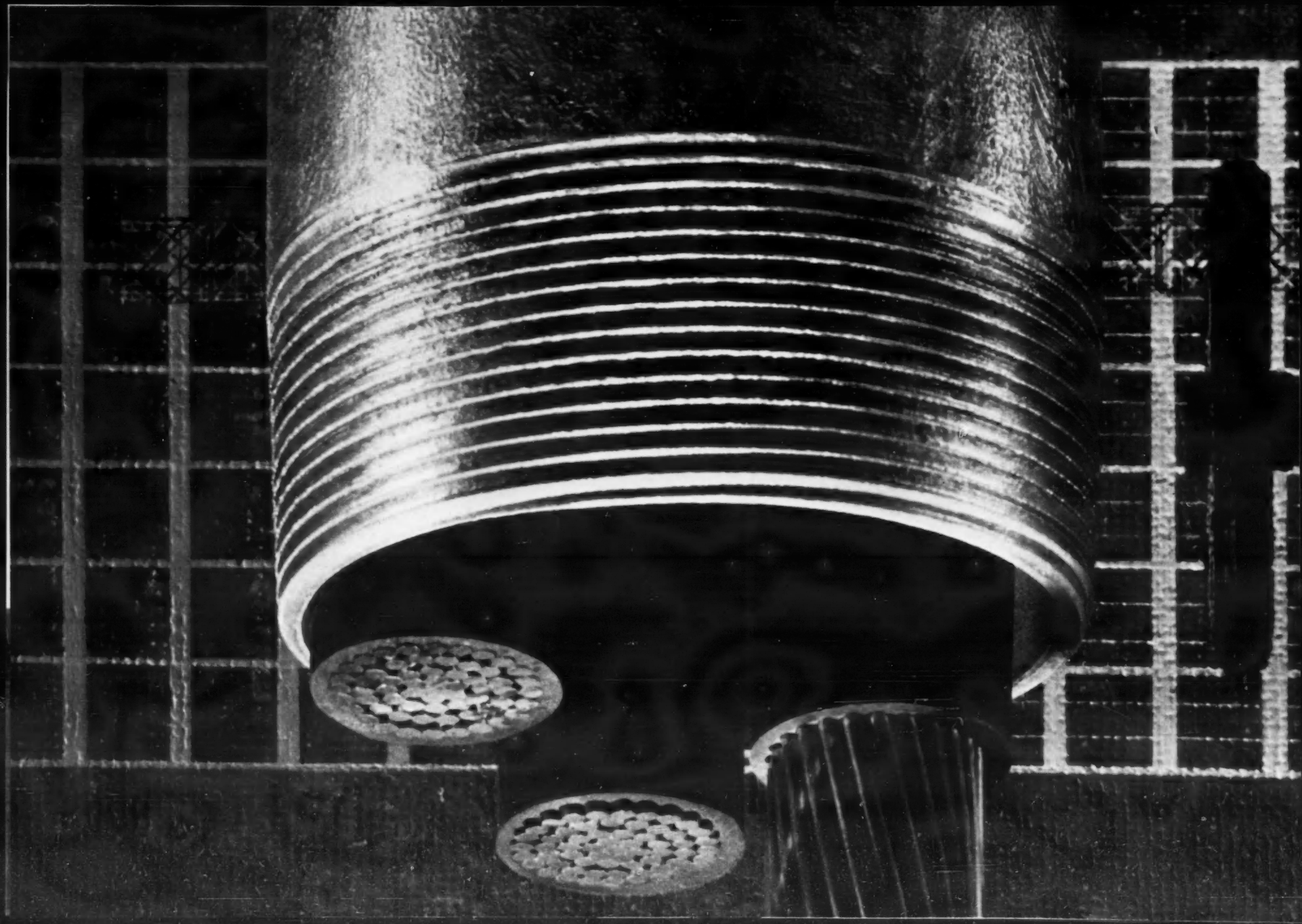

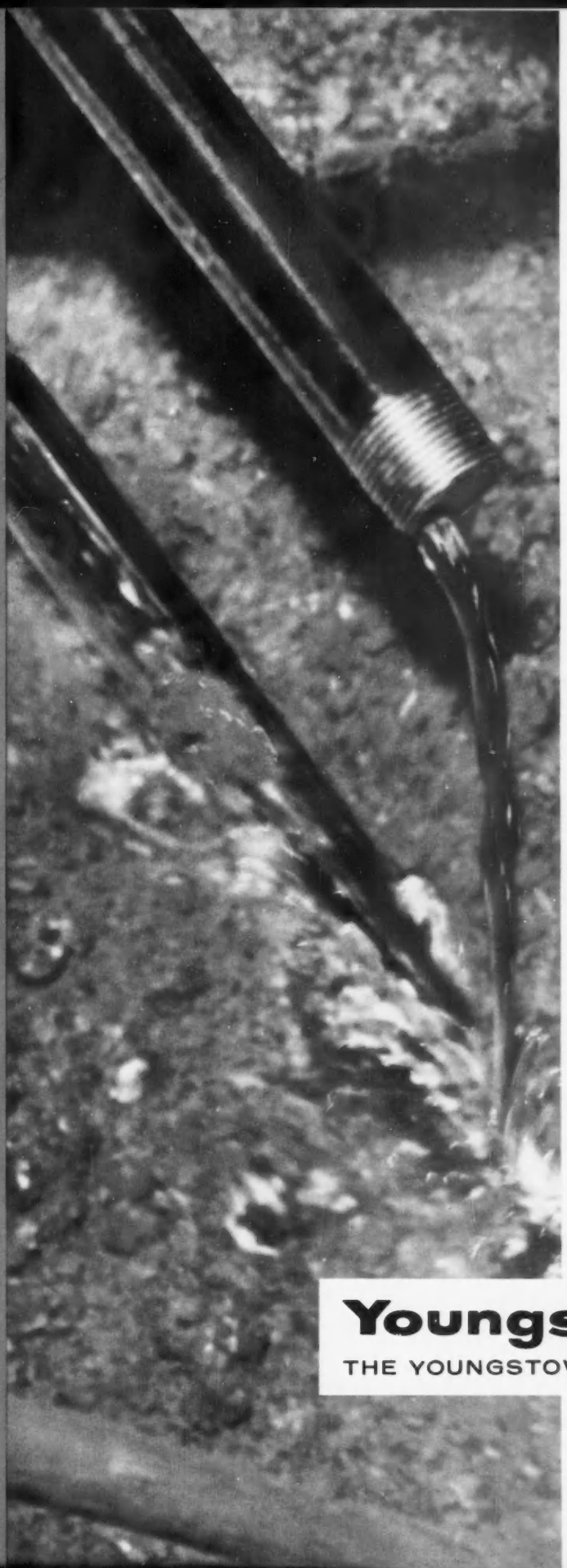

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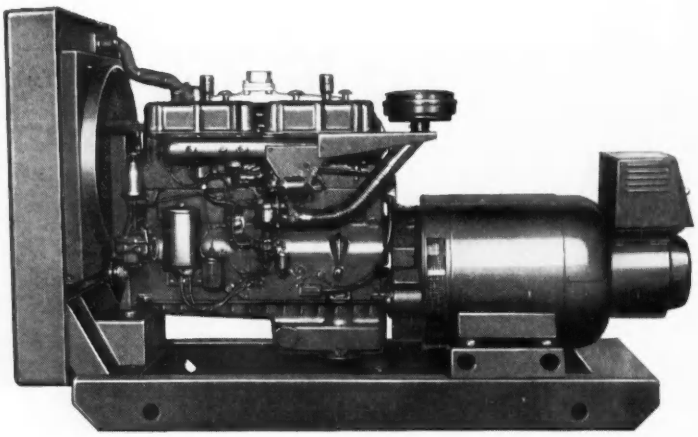

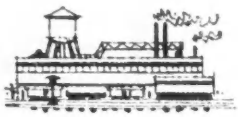

FOR INDUSTRY

Production lines, data processing equipment, office machines, lights and procedures of various types and kinds depend on electricity for power. Every additional piece of such equipment demands more power and requires additional stand-by power to meet vital emergency needs. Are your stand-by recommendations adequate?

FOR HOSPITALS

Only thirty-five per cent of all hospitals have sufficient stand-by power to meet every emergency in every part of a hospital. New wards, extra equipment, modernization programs call for more and more power. Can every patient be provided with all of the essential services when power failure hits?

FOR BUSINESS

Extra elevator, escalator facilities, improved lighting systems, added bookkeeping equipment, inter-office communications systems, air conditioning all call for extra power, more wattage. Can present stand-by plants supply full power for every new facility installed?

FOR BANKING

Power bookkeeping has made stand-by power more necessary than ever. Check sorters, computers, market ticker-tapes are constantly increasing the dependency on electric power. How much would a sixty-minute power failure cost your client?

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All-Electric Concept For Refrigerated Warehouse

Associated Foods recently constructed a huge central warehouse in Salt Lake City, designed for temporary storage of perishable foods sold through 250 shopping outlets in Utah and Nevada. In effect, the structure is a giant refrigerator where in some areas temperatures as low as minus 8° F are maintained to preserve frozen produce.

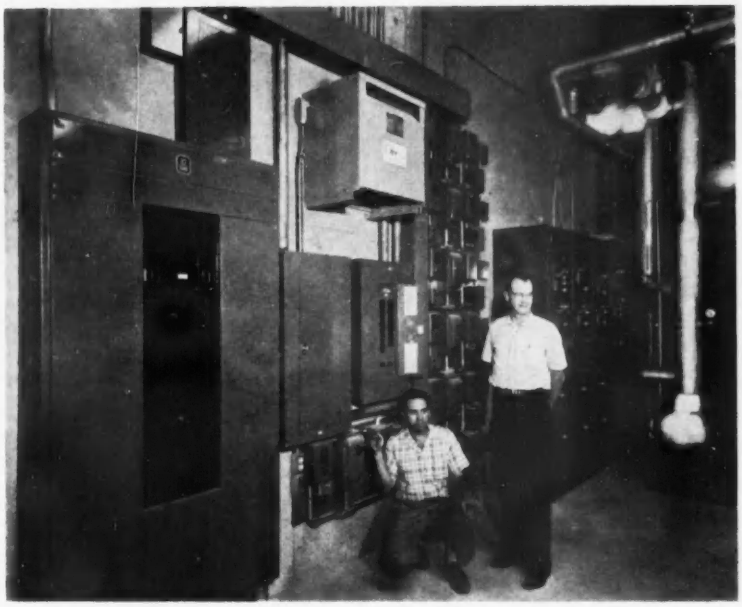
The building, however, does not limit its all-electric approach to just refrigeration, since heating of office space is accomplished by heat pump; drain pipes are prevented from freezing by wrapping them with heating cables; lighting combines several contrasting treatments, while the handling of goods is accomplished by means of several battery-operated fork trucks.

As defined by electrical contractor Irwin Thompson, the 55,000-sq-ft building is "nothing but" electrical; clean, since no fumes or dirt relate to conventional heating methods; having maximum usable floor space, because electrical equipment is compact and generally mounted overhead; conveniently operated, because controls are governed automatically by thermostats and time switches; and easily maintained, because air intake is filtered to exclude dust; and equipment is located to permit ready accessibility.

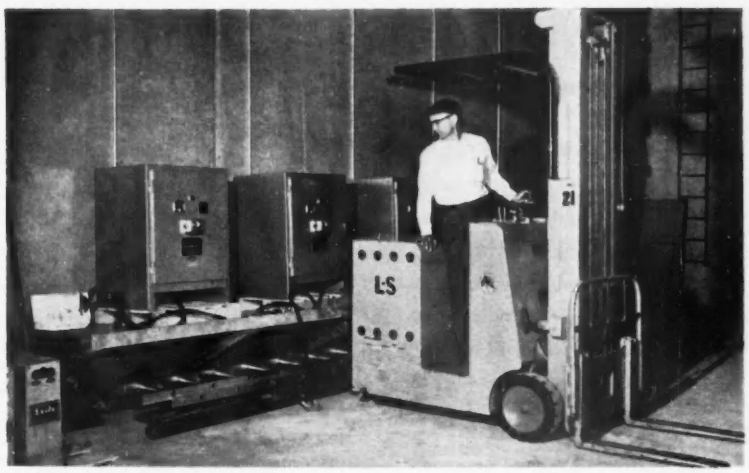
In this modern food storage depot lighting varies from—offices, where 100 footcandles of comfortable illumination is obtained by recessed troffers—to frozen food rooms, where jacketed T-10-J fluorescent lamps are installed in open-type fixtures. Areas subjected to high humidity contain vaporproof fluorescent luminaires that provide 50 fc

Lighting in these several areas is served from 277-volt circuits, although low-voltage switching is used for remote control. Where 110-volt service is required for office machines and similar purposes, local dry-type transformers are installed to power the receptacle outlets. And, to recharge batteries of fork-lift materials-handling trucks, automatic rectifier units are available for nightly regeneration.

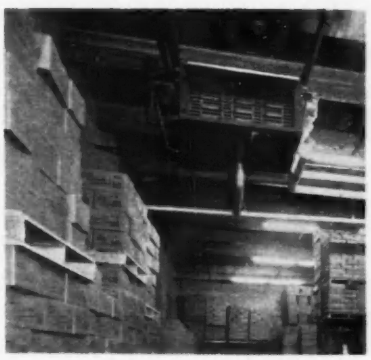
It is interesting to note that the decision to go all-electric was prompted primarily by economy. Consulting electrical engineer Vernon Proctor; consulting mechani-



SWITCHGEAR CONCENTRATION includes main breakers at left, 480/277-volt distribution panels, wall-mounted lightweight low-decibel intermediate transformer, 120-volt branch-circuit control, motor control center related to warehouse refrigeration and frozen food rooms. Check-out upon job completion was made by electrical contractor Irwin Thompson, standing, and foreman John Yates.



THREE RECTIFIER CHARGERS are available to regenerate power units of electric fork trucks used to shift and lift cases of foodstuffs in storage depot. Nightly charge permits trucks to operate constantly for 8 hours the following day.



BELOW ZERO temperatures are obtained in frozen food rooms by means of ceiling-suspended refrigeration units, while incorporated electric heaters are used for daily defrosting. Jacketed T-10-J fluorescent lamps placed in open fixtures provide 35 footcandles of illumination in these areas.

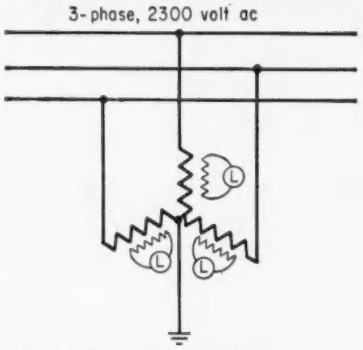
cal engineer Richard C. Brown; architect James C. Richie, Snedaker, Budd, Monroe and Associates, plus executives of Associated Foods were in complete agreement that an all-electric installation would provide the most economical overall answer to their combined heating-cooling-lighting-power needs. And, after a year of comparing installation and operating charges with similar installations of comparative size and purpose, this economic pre-conclusion has been verified by "cold facts."

Ground Detection on High-Voltage Feed

The following is a report from Lindsey Hoben, Oak Ridge, Tenn., describing use of a special hookup of potential transformers and signal lamps to warn against incipient ground faults on primary feeder circuits:

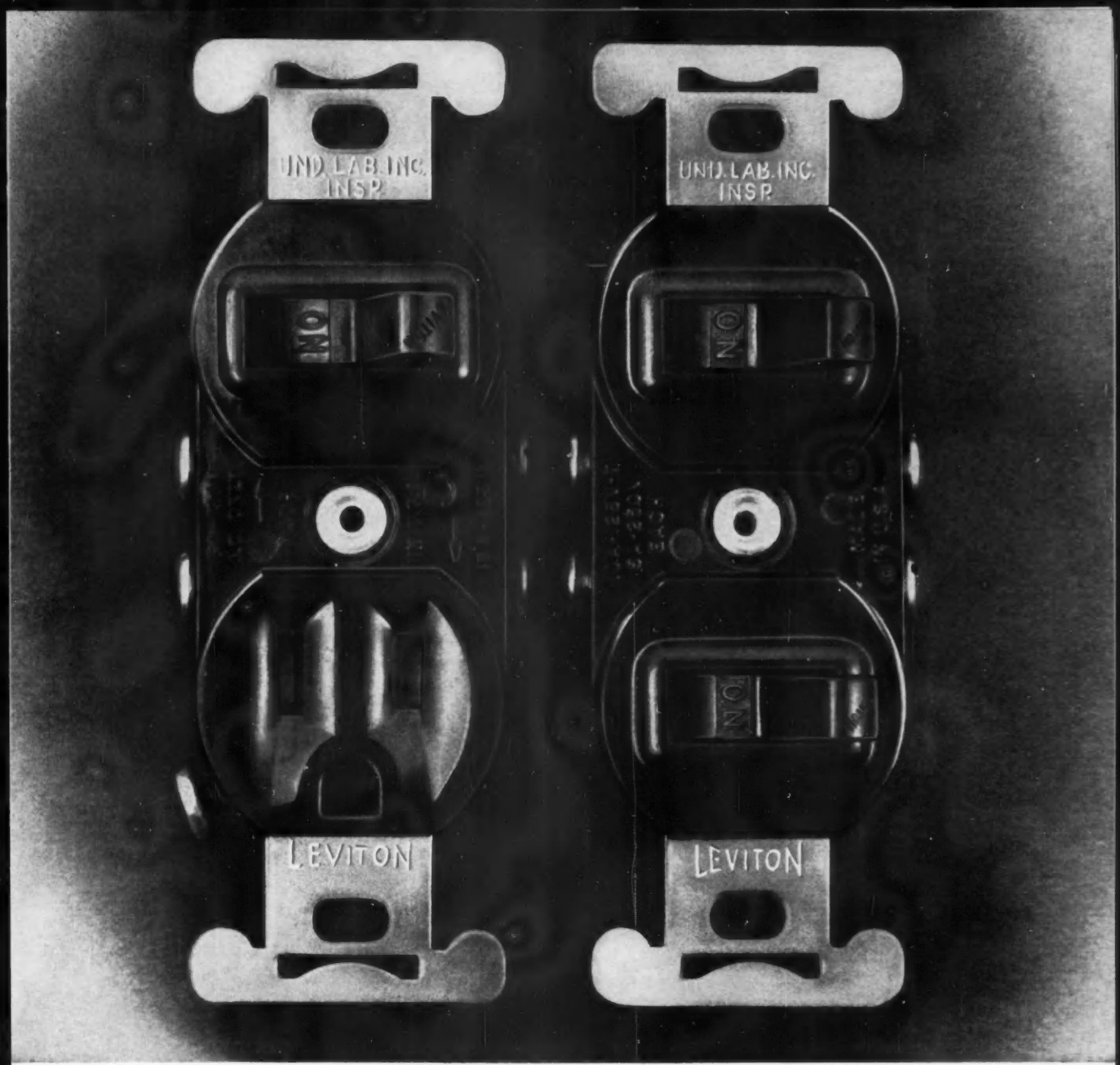
Electrically powered shovels and dewatering pumps operating in our coal strip mine are powered through trailing cables extending from skid-mounted transformer and switch-breaker cabinets. Since grounds of any type are undesired afflictions in this work, we had need for a warning device that could be readily assembled and maintained at a minimum cost.

The accompanying sketch shows how three potential-type transformers are utilized to furnish the low-voltage current by a wye connection. With everything shipshape and free of grounds the line voltage is 2400 volts while that of the secondary is 64 volts for the lamp supply. As a ground develops the lamp powered by the potential transformer hooked to that phase dims gradually, or darkens com-



Circuit of potential transformers coupled to three 5-watt, 120-v lamps.

Lamps burn on 64 volts with lines free of ground. One leg grounded brightens two lamps to full 120-volt brilliance.



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Forty years ago we introduced the first line of combination devices. Forty years later these tested, proven, universally accepted products are being specified in major installations across the country. There must be a reason. Maybe it's the scope of the line... more combinations to choose from than any other source—(the most complete line of AC Quiet Switches in the industry is included). Maybe it's the quality... sales in millions, returns and complaints practically nil. Maybe it's our research... a never-ending quest for newer, better ways to meet your every requirement. Whatever the reason (and we strongly suspect it's a combination of all three) Leviton Combination Devices bring you the assurance of quality and performance. ■ Our completely new illustrated brochure on the entire line belongs in your files. May we suggest you write to Dept. EC2 today? **Leviton Manufacturing Co., Inc., Brooklyn 22, New York.**

LEVITON

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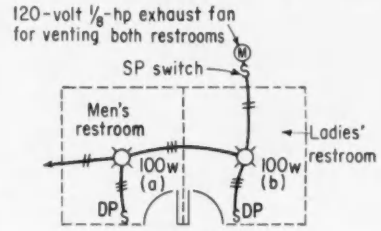
pletely, depending on the resistance to earth of the ground leg. Should the ground be "dead short," the remaining lamps brighten to the full 120-volt value since the transformers are now at peak voltage.

The lamps are mounted behind crystal bezels, mounted in the metal panel so that rays are thus intensified and can be more readily read from quite some distance. With phase designations stenciled over each bezel there is no confusion as to the location of trouble. Where an uninterrupted view is not readily maintained, the sight signal can be augmented by the use of relay arranged to sound a horn or bell as a direct ground develops.

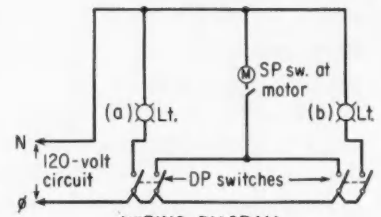
Troubleshooting is not attempted until lunch periods or shift-change time, to keep production rolling uninterrupted as long as possible.

DP Switches Solve Wiring Problem

On one of his wiring jobs, Frank Hotchkiss, an electrical contractor of Patchogue, N. Y., had the problem of providing control of a light in each of two rest rooms plus providing continuous operation of a single exhaust fan (which vents both rest rooms) when either or both lights were on. Job specifications stated that the flush wall switch in each rest room could control only the light in that room;

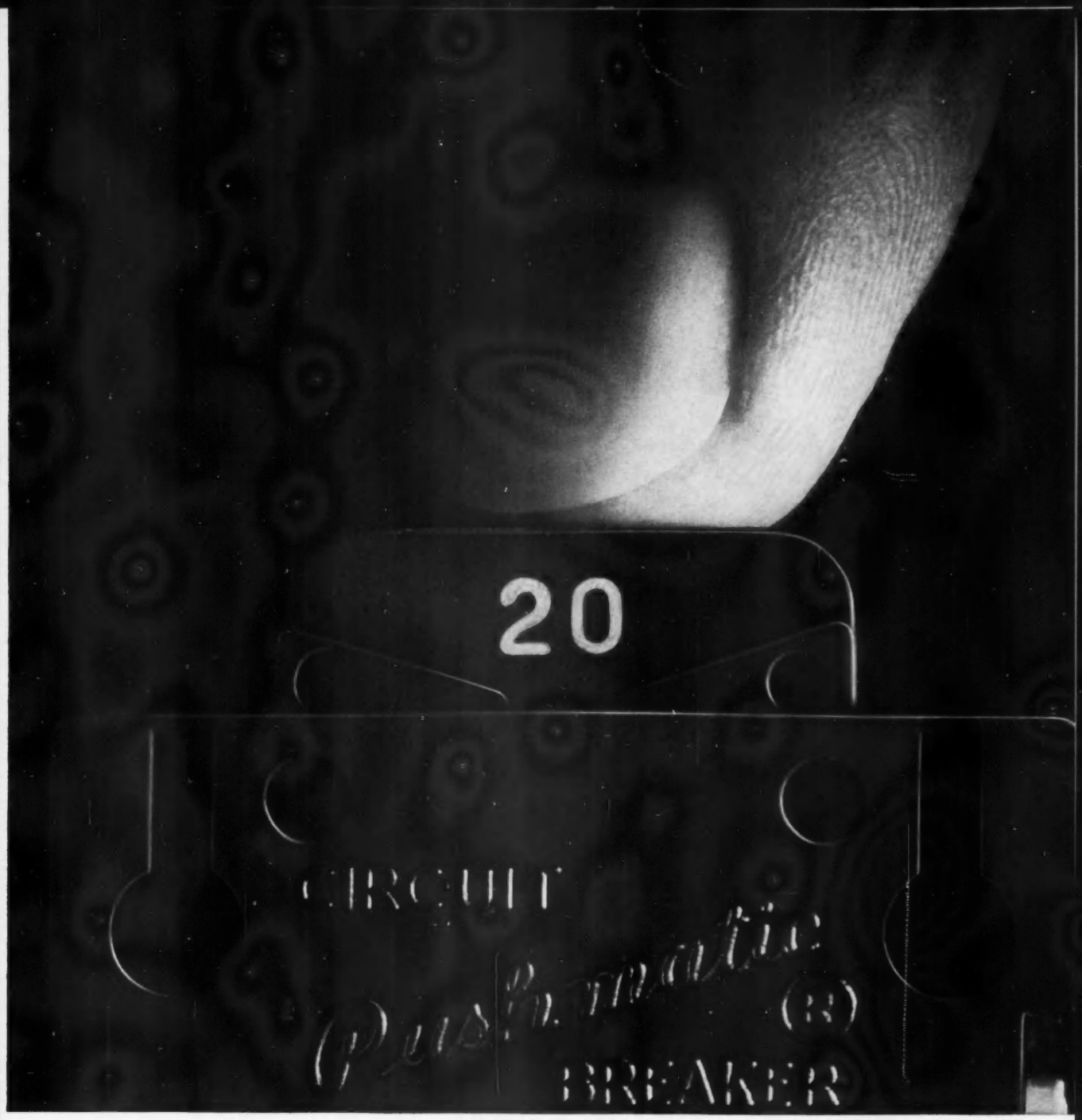


LINE DIAGRAM



WIRING DIAGRAM

TWO DP SWITCHES permit the control of individual lights, while starting a single exhaust fan when either switch is in the ON position. The fan is disconnected only if both DP switches are in the OFF position. Installed at the fan, a SP switch provides a disconnecting means when it is necessary to service the fan motor or related equipment.



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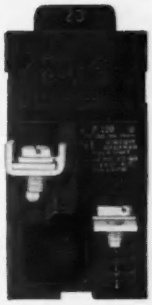

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and at the same time, the closing of either switch had to start the exhaust fan. After both switches were turned off, it was a requirement that the fan shut off.

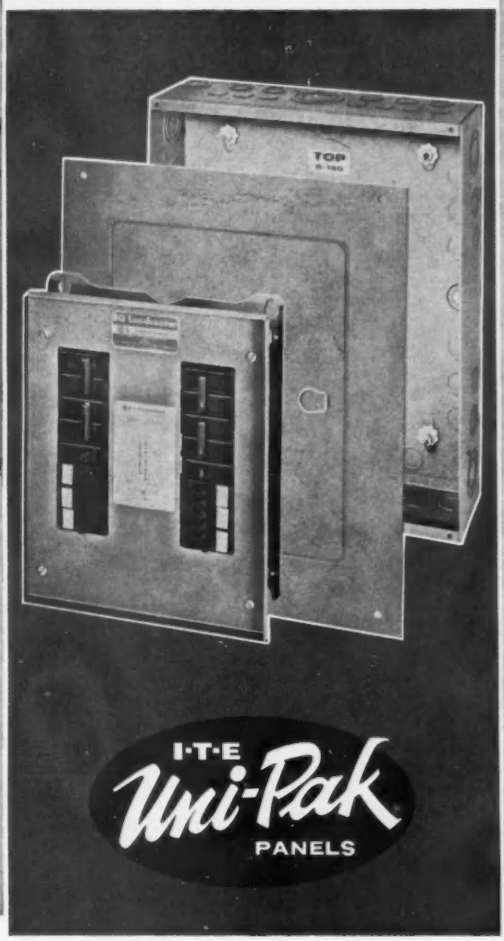
This unusual arrangement stems from building code rules that require the simultaneous operation of an exhaust fan and light by a single switch in inside bathrooms requiring mechanical ventilation. However, in the job in question, the architect chose to vent two rest rooms through a single exhaust fan, thereby eliminating the cost of an extra unit.

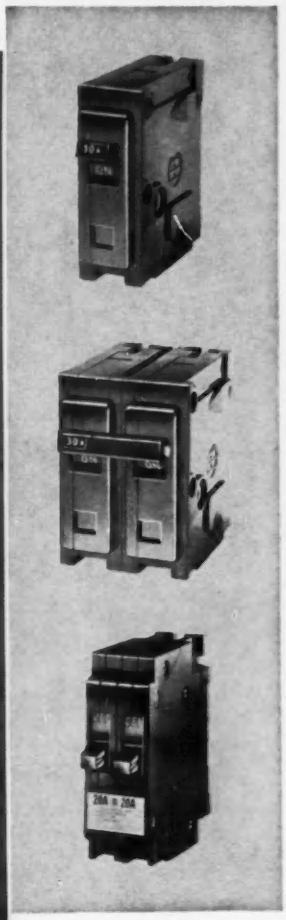
Hotchkiss solved the problem by using a double-pole, 15-amp, ac rated snap switch in each rest room. At each switch, one pole controlled its respective light, while the load sides of the second poles in both switches were tied together and formed a common connection to the fan motor. All poles on the line side of both DP switches were paralleled to the ungrounded branch-circuit conductor, and the neutral conductor fed one side of each light and the fan. Since both switches had to be in the OFF position to disconnect the motor, a SP switch was installed at the motor so that it could be safely serviced. As an added safety feature, the motor contains an inherent overload protective device that disconnects the motor if it stalls or is overloaded. Wiring connections are shown in an accompanying sketch.

Epoxy Resin Waterproofs Splices Outdoors

Waterproofing outdoor control-cable splices can often be troublesome and difficult. But a new and simplified technique developed by C & S Products Co., using epoxy resin, was recently applied with excellent results.

The problem of waterproofing outside multi-conductor cable arose during construction of the US Navy VLF (very low frequency) radio station at Cutler, Me. This 70-million dollar installation includes generators providing over two million watts of power, 1000-ft. high antenna arrays, and 200,000 ft of multi-purpose cable. Much of the multi-conductor cable is installed in ductlines and manholes, therefore the problem of protecting multi-conductor splices from seepage water was of paramount importance.





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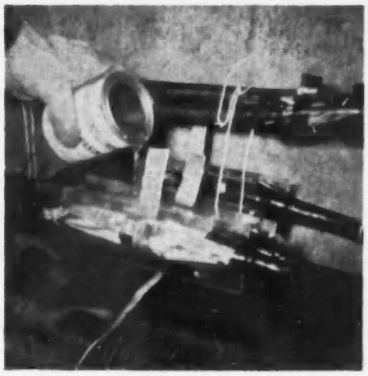
MULTI-CONDUCTOR SPLICES, when installed in wet locations, require positive waterproofing. Shown are a 26-pair cable and a 101-pair cable with PVC sleeves over connectors before application of plastic mold and epoxy resin.

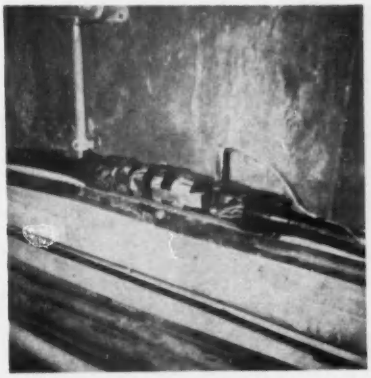


EPOXY RESIN and hardener mixture is poured into plastic mold. The fluid epoxy resin surrounds each conductor in the splice and, after hardening, forms solid protective core. Resin hardens in about 45 minutes.

For example, one particular case involved the entrance of water into some PVC jacketed, aluminum-shielded, polyethylene-insulated, No. 19 AWG multi-conductor cables that are part of several auxiliary systems needed to maintain the transmitter area of the station.

After consulting with C & S Products, the contracting firm, Nat Harrison Associates Inc., Miami, Fla., decided that the installation of Semper-Seal kits was the most practical solution to the problem.

Semper-Seal kits consist of plastic molds which are attached permanently over the splices and filled with an on-the-job, syrup-type mixture of epoxy resin and hardener. The liquid, which has an insulation value of 750 volts per mil, surrounded every conductor including the 101-pair cables and solidified in approximately 45 minutes. It penetrated 1-in. to 1½-in. longitudinally into the cables measuring from



COMPLETELY WATERPROOF, the cable splice will now effectively preclude water and moisture. The hardened plastic core can resist impact and has an insulation value of 750 volts per mil.

where the shield and jacket had been removed. With this hard core around each wire, water can not "short out" circuits. All the conductors were megohmed and loop-tested for continuity before and after the pouring process. Each one indicated a satisfactory reading.

The encapsulating of over 100 splices was accomplished at great savings. In the past, costly waterproofing devices included extensive nitrogen-purging operations, waterproof splice boxes and permanent dry-air pressure devices, none of which are required with this epoxy method.

HONORARY MEMBERSHIP in the Chicago Electrical Estimators Association is awarded to Walter E. Brand, vice president and chief engineer, Newbery Electric Corp., Los Angeles, Calif. Presenting mounted certificate is association president J. D. Garrison. Accepting for Brand is CEEA charter member Ray Ashley, a research and consulting engineer and recognized authority on electrical estimating. Before moving west, Mr. Brand was a member of the estimators association for some 20 years. He is credited with developing practical procedures for analyzing electrical installation labor costs, particularly in the roughing-in and cable-pulling operations.

115-KW LOAD IN RESIDENCE

[FROM PAGE 87]

tion of opposing heat loss from the house into the uninsulated attic crawl space. The insulation above the basement ceiling is required (even though the basement is heated) to prevent conduction heat loss up from the heating cable installed in the basement ceiling.

An important feature of electrical heating installations is control of relative humidity. In this house, exhaust fans operated by wall-mounted humidistats maintain an atmosphere containing about 35 to 45% relative humidity at 70°F. The fans eliminate buildup of moisture due to water usage (as in kitchen, bathrooms, laundry room). The humidistats sense objectionable moisture and automatically turn the fans "on" and "off" to keep a proper moisture level in the house. This eliminates such conditions as sweating windows, damaged window sills, moisture in the insulation (reducing its effectiveness), rot and damage to wood and peeling of paint.

An additional environment feature of this house is the air conditioning. Two air conditioning units in the attic crawl space—3-ton and 2-ton—share the cooling task. An interesting note on this installation is that the thorough insulation treatment of the house has kept the house cool enough through 90° outside temperatures without need for air conditioning.

Martin Katzman was the lighting consultant on this job.

Here's the Electrical Load . . .

Water Heaters (2 @ 9 kw)	18 kw
Air Conditioning	5 kw
Electric Cooking	14.8 kw
Clothes Dryer	4.6 kw
Lighting	12.6 kw
Space Heating (Ceiling Cable) in House	36.3 kw
Garage Heating (Ceiling Cable)	4.0 kw
Snow Removal Cable in Driveway	12.9 kw
Miscellaneous Load	6.5 kw
TOTAL LOAD	114.7 kw

Service Demand Capacity . . .

Two 4/0 per hot leg in 3-in. conduit = 2 x 230 amps x 80% (derating for 4-6 conductors) = 368 amps per hot leg
220 volts x 368 amps = 80 kw

Here's the Energy Cost Rate . . .

$6.00 for first 200 kwhr
2.05¢ per kwhr for next 200 kwhr (i.e., $10.10 for first 400 kwhr)
Plus 1.5¢ for each additional kwhr
(Plus raw material charge of 0.176¢ per kwhr over base rate charge)

You don't have to look down the barrel to load this piston tool

The new Nelson LO-V* powder-actuated piston tool is breech-loaded. Threaded and headed fasteners enter the tool at the top, and are actually pushed through wood and metal into concrete or steel. This makes the LO-V the world's safest piston tool. It's light, compact and rugged, too. Operators love the unique ejection system of the spent cartridge. Makes their fastening jobs simple and fast (as well as safe), and helps expedite the bosses' work flow, too. The Nelson LO-V uses safe, easy-to-work-with Powercaps for the most efficient use of powder power. Get full details today. Send for a free folder on the amazing new LO-V and universal HI-V powder-actuated tools. Dealer Inquiries Invited. NELSON DISTRIBUTOR PRODUCTS, Division of Gregory Industries, Inc., Dept. C, Lorain, Ohio.

*Low Velocity

GREGORY INDUSTRIES

ESTIMATING FORUM—XXII

[FROM PAGE 91]

With a sell or contract price that is 130% of the base cost, the multiplier for base cost determination is 1/130, or 0.77 (see Fig. 1, Col. 9).

Since material and labor are respectively 60% and 40% of the base job cost, the multipliers for these items are:

Material—60% of 0.770 = 0.462 (Fig. 1, Col. 10)

Labor—40% of 0.770 = 0.308 (Fig. 1, Col. 11)

The labor rate is $4.00 per hour. Therefore, the number of labor hours is ¼ the number of labor dollars. It follows that the multiplier for the labor hours will be ¼ that for the labor dollars. Hence, this multiplier is:

Labor Hours—¼ × 0.308 = 0.077 (Fig. 1, Col. 12)

In the Fig. 2 estimate, the labor insurance was listed in the labor column and subject to a 10% markup. It is also good practice to list insurance in the material column and treat it as a merchandising item. It has been frequently stated that such a listing may have a sales value.

If the insurance had been listed in the material column along with the direct job costs, it would have been subject to a 7% and 5% markup. This would have increased the estimated price about 0.8%.

Base Cost Range

From an over-all study of Fig. 1, we learn the following interesting facts about projects with a MLR in the 60/40 category:

Base Costs (Job) range from 70% to 80% of the contract price.

Material Costs range from 40% (for jobs less than $5,000) to 48% for projects in the $3/4 million class.

Labor costs run from 25% (for small jobs with high markups) to 32% of the estimated sell price.

Estimator Experience

Experienced estimators rely a great deal on the knowledge they have of completed projects and the percentages they have fixed in their minds. However, they must proceed carefully if they step out of their ordinary line of work. Direct job costs and duration are two items demanding careful study when special projects are involved.

More than 65,000 ft. of SPANG Steel Conduit is installed in the new $2,000,000 St. Mary's Dominican High School, New Orleans, Louisiana. Conduit will protect wiring for general lighting, phones, air conditioning and electric heating, television, commercial system and clocks.

Want dependability? Try SPANG®!

You'll get it all the way—from on-time delivery to trouble-free installation.

Take the case of Lindsey & Morgan, the New Orleans electrical construction company that installed 65,000 ft. of SPANG Steel Conduit, made by Armco, at St. Mary's Dominican High School. Here's how L & M Partner Ralph Morgan ticked off the SPANG-dependability on this job:

- Conduit at the job site ahead of schedule.
- Bundled in steel strapping for easy handling, no bent lengths.
- Color-coded thread protectors for fast identification.
- Uniform product made for easy cutting, bending and threading.
- Smooth interior finish facilitated wire-pulling.
- Makes good appearance in exposed locations.
- All threads were in "go" condition despite long outdoor storage of some bundles.

Dependability? Yes, indeed! For this reason alone, Lindsey & Morgan uses Armco's SPANG Conduit regularly. And so should you. See your local SPANG Distributor.

For more information, write *Armco Steel Corporation, Armco Division, Middletown, Ohio.*

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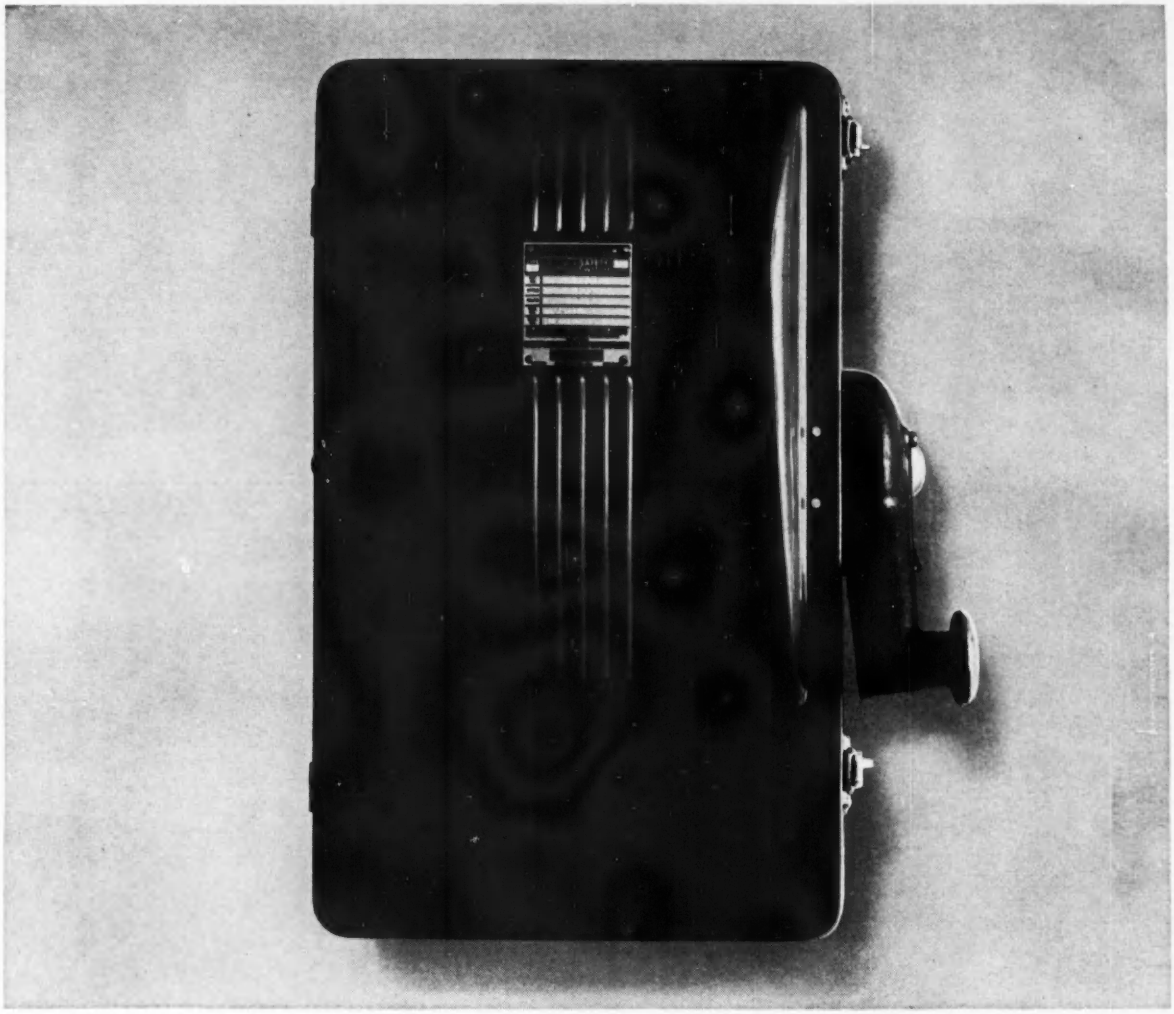
Consulting Electrical Engineers: Guillot, Sullivan & Vogt, New Orleans
General Contractor: Perrilliat-Rickey Construction Co., Inc., New Orleans
Electrical Contractor: Lindsey & Morgan, New Orleans
SPANG Distributor: Woodward, Wight & Co., Ltd., New Orleans

ARMCO **Armco Division**



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Wheeling Steel knows the value of cooler safety switch operation. Hundreds of Westinghouse switches have given years of trouble-free performance at their Steubenville, Ohio, plant.

Cool switches last much longer, and Westinghouse makes the coolest safety switch you can find.

Take the contact area, for instance, where most heat is produced. An exclusive Westinghouse design has completely eliminated arcs from the contact area. Burning and beading don't exist there. Contacts last longer.

The De-ion arc quencher reduces heat by snuffing out arcs quickly. Joints produce heat, so Westinghouse eliminates joints with one-piece copper construction. Heat is reduced, and conductivity is improved.

Tin-plating of copper parts further reduces both heating and wear by providing lubrication, and corrosion resistance. These features help make Westinghouse the best buy in safety switches. Ask your Westinghouse representative for complete details, or write Westinghouse Electric Corporation, Standard Control Division, Beaver, Pa. *You can be sure . . . if it's* **Westinghouse**

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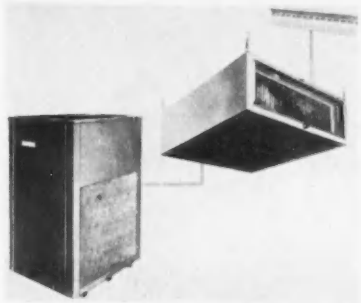


Comfort Conditioning System (1)

In an all-electric, all-season approach to whole-house climate control, a new Chromalox Season-Aire electric comfort conditioning system has been announced. System includes a basic electric heating section, plus cooling, electrostatic filtering and cleaning, humidifying, dehumidifying, circulating, ventilating and deodorizing. These latter features can be added on as desired or all supplied as one complete system. One of the features is the patented air distributing baseboards located in each room with individual temperature control. These baseboards, called Smooth-Air units, are installed on outside walls and below windows and deliver conditioned warm or cool air into each room in a precise pattern. For room-by-room heating control in winter, a metal-sheathed electric heater located in the air supply of each unit and controlled by a thermostat keeps the room temperature at preset comfort level. The main part of the basic electric heating system is the Central-Air unit containing a twin impeller fan that moves the air at slow speed over a bank of metal sheathed heaters.

Edwin L. Wiegand Co., 7500 Thomas Blvd., Pittsburgh 8, Pa.

Clamp (2)

A new small mounting clamp for holding Ty-Rap installed wires, harnesses, conduit and cable has been introduced. Designed to fit snugly under the harness, the clamp is quickly installed with a No. 6 screw or rivet. Installation of clamp is made at the most convenient time before harness or cable is put in place. The Ty-Rap cable tie or identification strap is then slipped under the slot in the clamp and around the wire bundle. One clamp size with Ty-Rap ties or straps will accommodate wire bundles from ¼ in. to 4-in. dia. Clamp is ¾ in. long, ½ in. wide and ⅛ in. high. It will accommodate all sizes of Ty-Rap cable ties and identification straps.

Thomas & Betts Co., Inc., Elizabeth 1, N. J.

Ballast (3)

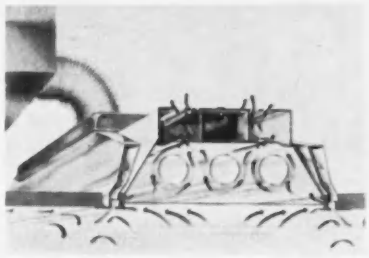
A new ballast for use with 175-watt mercury vapor lamps is designed to operate with the new Banner Line of mercury vapor lamps. It provides reliable starting at minus 20°F. It has been designed for incorporation in unitized mercury vapor lamp heads. Ballasts weigh approximately 6¾ lbs. They are provided with input taps for 115, 120 and 125 volts. Class "F" insulation is used to allow ballast to operate in temperature up to 155°F.

Transformer Dept., Sylvania Electric Products Inc., Estes St., Ipswich, Mass.

Lighting Fixtures (4)

New "Flair Line" area and service station island lighting fixtures are available. Featuring a slim curved design, the line includes two series. "Flair" series is the basic unit, available in 32 models. It is furnished with 3, 4 or 6 lamps, in 18-in. or 24-in. widths and 6-ft or 8-ft lengths. "Royal Flair" is the deluxe series in this line. Four models are available, each with 6 lamps. They are furnished in 24-in. width only, in 6-ft or 8-ft lengths. It features a fluted, white acrylic plastic enclosure.

Guardian Light Co., Oak Park, Ill.



Recessed Fixture (5)

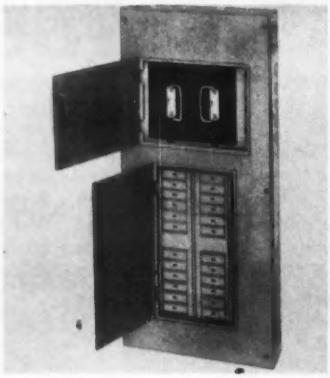
Recessed lighting fixtures which remove the heat they generate before it enters the occupied space have been introduced. Heat produced by lighting units can be removed at the rate of 200 to 400 Btu per hour for each fixture. Fixture generated heat is removed into the plenum area above the ceiling and exhausted or recirculated through the cooling system. Air from room is drawn into fixture, entering around edges of diffuser and goes out through air slots in top of troffer. Lighting characteristics also are improved because heat removal reduces operating temperature of fluorescent lamps. The heat removal principle has been applied to two fixtures—the shallow line troffer and the multi-purpose Lumi-Flo air-supply unit.

Benjamin Div., Thomas Industries, Inc., 207 East Broadway, Louisville 2, Ky.

Clamp-Type Terminal (6)

A new saw-tooth, clamp-type terminal that provides increased wire holding power and improved electrical conductivity is now being offered on specification grounding devices. Clamp permits either back or side wiring. Eight openings in the base allow insertion of Nos. 10, 12 or 14 AWG wire for gripping by the saw-tooth edges, or the wires can be attached to the side of the devices with conventional screw terminals. Devices have double-wipe parallel contacts and triple-wipe grounding contacts. Break-off link will permit split wiring. It has been listed by UL and meets all Federal and REA specifications. It is available on double-outlet grounding devices rated 15 amps, 125 volts and 15 amps, 250 volts, with or without outlet box cover; 20 amps, 125 volts; and 20-amp, 125-volt outlets.

Wiring Device Dept., General Electric Co., Providence, R. I.



Load Center (7)

A new 200-amp main disconnect load center for the all-electric home. It is a 200-amp main lugs only, split bus device, with fusible service disconnect and circuit-breaker branch circuits. It has two 100-amp fusible pullouts, and 24 to 40 breaker branch circuits. One 100-amp fusible pullout disconnect protects one of the branch-circuit sections and the other disconnect protects the second branch section. Lighting and appliance circuits may be connected to one section and heating circuits could be connected to other section. The door-trim is the E-Z removable type, interchangeable for flush or surface, equipped with two doors. Separate dead-fronts are of the new hook-on type.

Wadsworth Electric Mfg. Co., Inc., Covington, Ky.

Snow Melter (8)

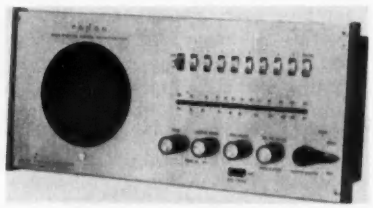
Electric "Snow-Mats" for embedding in blacktop to keep driveways, parking areas, walks, etc., free of snow and ice have been developed. They are completely assembled units of pre-spaced electric Line-O-Heat cable, for use on 230-240 volts, ac. They are 18 in. wide and available in 5-, 10-, 20- and 40-ft lengths for installation in limitless patterns and combinations. Each mast has 10-ft, non-heating, color-coded leads plus a positive braided ground encasing the heater.

Smith-Gates Corp., Farmington, Conn.

Test Units (9)

Two lines of high-voltage power supply units—one for ac testing and the other for dc testing—are available for a wide variety of dielectric tests according to recommendations of ASTM D-149. Models HA are designed for ac testing. They include six portable types with outputs ranging from 2.5 to 25 kv; 16 mobile, bench and console types with outputs from 5 kv through 25 kv; and six console types with outputs of 50 to 75 kv. Models HD are designed for dc testing. They include seven portable types with outputs ranging from 5 to 25 kv, and eight bench and console types with outputs from 25 through 100 kv.

Multi-Volt Div., Multi-Amp Electronic Corp., Cranford, N. J.



Radio-Intercom System (10)

New model 5500 AM/FM home radio-intercom system consists of a master and up to nine remotes. It is styled for flush-wall installation. The FM tuner is equipped with an automatic frequency control (AFC) which prevents drift. An AFC-off switch facilitates tuning in of weak or distant stations. As an intercom, both the master unit and any of the remotes may call one another. Pre-switching at master unit enables one remote to talk directly, and in privacy with any other remote.

Fanon Electronic Industries, Inc., 439 Frelinghuysen Ave., Newark 14, N. J.

Thermostat (11)

A "Dual-Duty" control which combines an electric heat thermostat with a complete mounting plate arrangement which permits inclusion of switches, receptacles and/or signal lights in the same enclosure has been announced. Unit mounts on a standard two-gang switch box or 4 in. by 4 in. outlet box. Type 1A65-441 has single pole thermostat; Type 1A66-441 has double-pole disconnect thermostat with positive "off" dial position.

White-Rodgers Co., 9797 Reavis Rd., St. Louis 23, Mo.

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2. Conforms perfectly for perfect splicing
3. Controlled stretch — no dangerous thinning
4. Built-in "grab" — snugs and stays down
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PLASTIC ELECTRICAL TAPE

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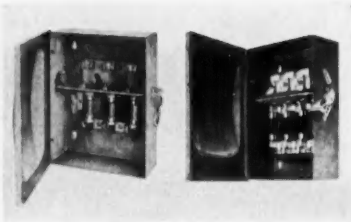
QUALITY SINCE 1896 CANTON, MASSACHUSETTS

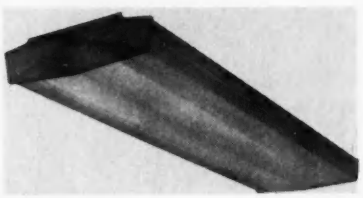
Makers of SLIPKNOT FRICTION TAPE — most widely used in the world



Safety Switches (12)

A new line of safety switches designed for positive protection on residential, commercial and industrial applications has been announced. Line includes heavy duty and light duty fused switches with visible knife blade contacts that tell at a glance when circuit is disconnected. There is provision for use of from one to three padlocks. Heavy duty switches include units for operation at 30, 60, 100 and 200 amps; 250 volts dc and 240-480-600 volts ac in NEMA 1 enclosures. Other units rated up to 1200 amps are also available. Light duty switches for residential and commercial applications are designed for operation at 30, 60, 100 and 200 amps; 240 volts ac in NEMA 1 and NEMA 3R (raintight) enclosures. Others for operation at up to 400 amps are available.

Arrow-Hart & Hegeman Electric Co., Hartford, Conn.



Luminaires (13)

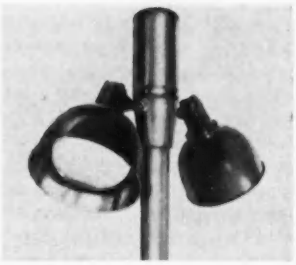
The LPI Criterion I and Criterion II fluorescent luminaires are now listed by UL for direct surface mounting on combustible, low-density cellulose fiberboard ceilings. They feature completely luminous design and incorporate ballasts with automatic resetting thermostats. Criterion I luminaire complies with the IES "scissors curve" criteria for limiting direct glare. The Criterion II is identical in appearance and provides higher footcandle levels with excellent brightness control, but it is not designed to comply with the "scissors curve." Luminaires use lamps up to 3100 lumens, and are available in 2-lamp and 4-lamp-tandem models. Bulletin is available.

Lighting Products Inc., Highland Park, Ill.

Adhesive-Sealant **(14)**

A new all-purpose silicone rubber adhesive-sealant in a squeeze tube that requires no added catalyst, which adheres to most materials without priming, has been placed on the market. Identified as RTV-102, the material can be applied from the tube and cures in place at room temperature to form a durable, resilient silicone rubber. It is capable of withstanding temperatures from minus 75°F to 300°F for extended periods and up to 500°F for shorter time periods.

General Electric Co., Waterford, N. Y.



Lighting **(15)**

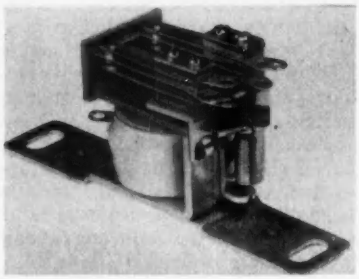
A complete mercury vapor lighting package permits more wide-area lighting with a new 2-lamp 1000-watt ballast. The "Dual-1000" constant wattage ballast is available for mounting in pole-base or pole-top as a complete assembly that includes ballast, pole-top adapter, and all-aluminum floodlights designed specifically for high-efficiency 1000-watt R-80 color-improved mercury lamps with sealed-in silvered reflectors.

Stonco Electric Products Co., Kenilworth, N. J.

Gearmotor **(16)**

New double-reduction, parallel-shaft gearmotor designated Type 5 GD has been introduced. Features include: a pyramidal case; a solid-shank, built-in primary pinion; a one-piece supporting case; normalized castings. In addition to standard dripproof motor, which is normally supplied, the 5 GD can be provided in totally-enclosed and explosion-proof models. The 5 GD is also available with the new Everseal encapsulated windings for applications where positive protection is required against salt spray, chemicals, water, heat, cold, or any adverse environment. Literature is available.

U. S. Electrical Motors Inc., Los Angeles, Calif.



Relays (17)

A new line of DPDT general purpose relays, strap-mounted for installation into surface or flush outlet boxes, is available. Designed for both replacement and new construction use, the relay line consists of ten models (five with ac voltage coils and five with dc voltage coils) to cover 60 possible contractor applications. Contacts, rated at 10 amps, are silver with a diffused surface of pure gold. Coils are wound on nylon bobbins, and wrapped with acetate yarn, while springs are made of stainless steel. Terminals are pretinned solder lugs, and all ferrous parts have cadmium plate and chromate film finish. Voltages range from 6 volts to 250 volts, both ac and dc.

Edwards Co., Inc., Norwalk, Conn.

Lighting Fixture (18)

Alzak high intensity high bay lighting for incandescent or mercury vapor lamps in both direct and uplight styles is now available. Vented neck construction assures proper operating temperatures. Multiple grouping arrangements are available. Duratch, Durex and solid neck styles. Catalog is available.

Wheeler Reflector Co., Inc., Hanson, Mass.

Drill (19)

A new masonry drill, electric-powered Model "300-E" handles diamond bits up to 6 in. in diameter. It weighs 60 lbs. Features

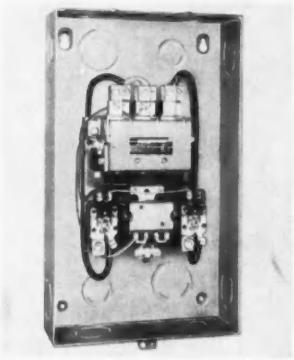
include a friction-free screw feed and hand crank that is built "on the angle." An adjustable column-mount adapter is provided for use with different length or diameter pipes. A carrying handle projects from drill's 2-hp electric motor. Special cast aluminum alloy base permits drilling next to walls and in corners. A power box is provided on the "300-E" with on-off switch and convenient outlet for electrical accessories.

E. J. Longyear Co., Longyear Building, Minneapolis 2, Minn.

Ballast **(20)**

A new plastic-sign fluorescent lamp ballast capable of operating any four-lamp combination of 6-, 7-, or 8-ft slimline lamps has been introduced. Designated model 6G3669G14, the ballast is supplied in white bonderized case with 14-gauge leads. It meets requirements for lamp starting in ambient temperatures as low as 0 degrees F. It is listed by UL.

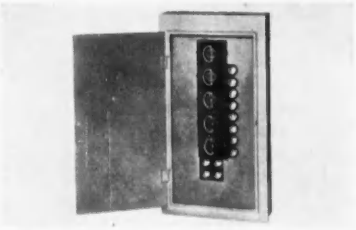
General Electric Co., Schenectady 5, N. Y.



Starter **(21)**

A new Size 4 magnetic starter which features more wiring room has been introduced. It has a tamper-proof, non-mechanically linked trip-free thermal overload relay. It is offered with a choice of bimetal, compensated or non-compensated thermal relays as well as melting alloy relay. It has dual voltage, dual frequency coils, 110/220 or 220/440, 50/60 cycles. Coils are encapsulated in an epoxy resin resistant to fungus, combustion, impact and moisture. Pressure terminals throughout permit rapid installation. Bulletin 14-B4 is available.

Furnas Electric Co., 1067 McKee St., Batavia, Ill.



Switch (22)

A new service entrance switch with five pullouts and 12 plug-fuse circuits has been introduced. The parallel type switch is designed with one 60-amp lighting pullout controlling 12 30-amp plug-fuse circuits, one 60-amp and three 30-amp utility pullouts. The plug-fuse circuits are for lighting, appliance and electric-heating loads. Switch is built with 150-amp line lugs for 120-240-volt, 3-wire, solid-neutral installations. Both surface-mounting and flush-mounting enclosures are available.

American Electric Switch Div., Clark Controller Co., 1146 *East* 152d *St., Cleveland* 10, *Ohio*

Abrasive Cut-Off Machines (23)

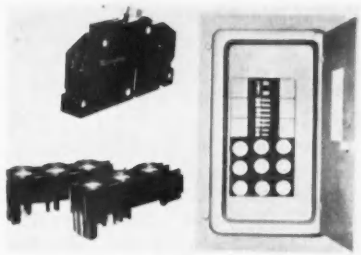
A new line of abrasive cut-off machines for handling exacting metal cutting requirements has been announced. The line includes three, dry cutting models—two straight cutting machines and one swivel-type, for angle cuts up to 60°. The 14-in. straight cutting models can be used either as a bench model or with stand. Its capacity covers most 4 in. structural shapes and up to 2 in. solid stock. Either manual or magnetic starter control, with overload protection is available. The 20-in. unit is a heavy duty, straight cutting model, for production cutting of larger diameters. The 20-in. angle cutting model has a pivot built into the base.

Oster Manufacturing Co., Div. of Plymouth Corp., Wickliffe, Ohio

Substations (24)

Previously available with 3-phase capacities from 75 to 500 kva self-cooled, Power-Zone package unit substations now are offered with a forced-air cooling system which increases capacity to 667 kva. The new system is equipped with a temperature alarm to permit maximum output without damage. Fused or non-fused load break air interrupter switches or oil cutouts may be specified for primary sections. Transformer sections feature 3-phase Class H insulated ventilated dry-type transformers. Secondaries can be equipped with molded case circuit breakers, fusible switches and/or motor starters. Bulletins 6110 and SD-234 are available.

Square D Co., Mercer Road, Lexington, Ky.



Plug-In Fuse Units (25)

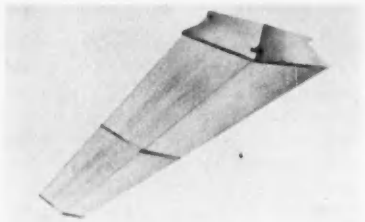
Fuses and breakers are mixed in same box with new plug-in units. Circuit breakers and fusible units are completely "plug-in." All are field installed. With this new choice of installation, contractor can use plug-in main breakers; twin size breakers for appliance circuits; and either breakers or plug fuse units for lighting circuits. Literature is available.

Zinsco Electrical Products, 729 Turner St., Los Angeles 1, Calif.

Lamp (26)

A new lamp, especially designed for the Chavez Ravine Dodger Stadium, is now available for general commercial and industrial use. It is a 1200-watt R80 incandescent Hi-Spot lamp with an internal silver reflector. Designed with an average rated life of 1500 hours at 120 volts, this light source produces a minimum of 250,000 beam candlepower. The R80 is made from "Pyrex" glass and can be used outdoors in such locations as sports fields, railroad yards, parking lots and loading areas.

Radiant Lamp Corp., Newark, N. J.



Fluorescent Fixture (27)

Two new fluorescent lighting fixtures, Sabre 12 and Sabre 16, have been announced. They are designed to provide high lighting efficiency with good brightness control in the lighting of stores, schools and offices. The Sabre 12 is a 2-lamp fixture, 13⅜ in. wide; the Sabre 16 is a 2-, 3- or 4-lamp fixture, 17⅜ in. wide. Both are available in 4- and 8-ft lengths. The self-hinging closure in convenient 4-ft lengths provides easy access from either side for relamping and cleaning. Brochure is available.

Miller Co., Meriden, Conn.

Fittings (28)

Flexible steel conduit screw-in connectors and couplings have been announced. They include "screw in" or "twist-in" connectors and couplings for ½-, ¾- and 1-in. flexible steel conduit. Die cast construction enables the installer to screw these fittings into the Flex. They are UL listed. Catalog is available.

Allen-Stevens Conduit Fittings Corp., 33-53 62*d St., Woodside* 77, *N. Y.*

Switch (29)

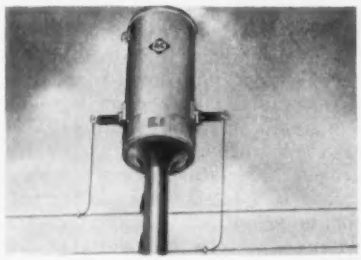
New ac reversing drum switches are available in two sizes to cover manual polyphase reversing requirements through 7½ hp. An adjustable control lever for remote operation—one of a choice of operators—can be rotated 360°. The selection feature provides adjustability to any one of 16 positions and permits easy operation of switches mounted at awkward angles or in confined locations. Two basic mechanisms are available—field convertible from maintained in both directions to momentary in both directions; and convertible from maintained-left, spring returned-right, to maintained-right, spring returned-left. Devices are available in NEMA 1 enclosures for surface mounting and as flush type units for oiltight, machine-cavity mounting.

Cutler-Hammer, Inc., 228 *N.* 12*th St., Milwaukee* 1, *Wis.*

Lamps (30)

A new line of beam-controlled mercury vapor lamps which have their own metallic reflector built into the bulb, has been introduced. They will be available initially in 400-watt R60 bulb and 1000-watt R80 bulb sizes, and are expected to have many applications in the commercial and industrial field as well as for recreational lighting. The lamps have a useful life of 12,000 to 15,000 hours. The R60 and R80 lamps operate on standard ballasts.

Westinghouse Electric Corp., Bloomfield, N. J.



Transformer (31)

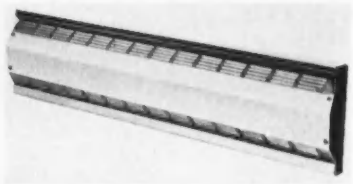
A new concept in distribution transformers in which the tank arrangement is a functional part of the lighting pole has been introduced. Available in a standard range of sizes, 50 kva, 18 kv and below, the transformer has its circuit breaker at the bottom of the rounded tank. Secondary terminals project from transformer base into a connection compartment equipped with access panels. Secondary voltage needs are served by directing low voltage lines down through the hollow support pole and underground.

Allis-Chalmers Manufacturing Co., Milwaukee 1, Wis.

Amplifier (32)

New electric magnetic amplifier has self saturating bias winding. This line of amplifiers combines solid state electronic components with magnetic reactors. The 60-cycle, input line is tapped and by means of silicon diodes is converted to direct current thus obtaining self saturation of the bias winding. Signal and load circuits are isolated. Unit is completely enclosed in ventilated case and supplied with meter mounted on front panel. Standard units are available in seven sizes from 5 to 1000 watts, 24, 80 or 160 volts dc; 120 or 240 volts ac.

Acme Electric Corp., Cuba, N. Y.



Electric Heat **(33)**

A new line of baseboard electric convectors, designed as Circle-Air Safe-T-Shape, has been announced. The Safe-T-Shape makes it impossible for furniture or drapes to block the air intake or discharge louvers. They are available in 600-, 750-, 1000-, 1200-, 1500- and 2000-watt capacities in a choice of 120, 208 or 240 volts. Units are mounted directly to wall, with a maximum projection of 2½ in. Convectors are available with or without factory installed thermostats.

Circle-Air Industries Inc., 244 *Herkimer St., Brooklyn* 17, *N. Y.*

Transformer **(34)**

A new pole-mounted distribution transformer is available in ratings to 167 kva. Model DO-65 employs a high temperature "Hypoxseal" insulation system which operates at 65°C average winding temperature. The system permits reductions in weight and size and provides greater life expectancy. Transformers feature a new wound core. Literature is available.

Federal Pacific Electric Co., 50 *Paris St., Newark, N. J.*

Pipe Wrench **(35)**

A new threaded pipe wrench eliminates damage to fittings and pipe or nipple in make-up or extracting work. Patented action eliminates crushing and tension; and pipe wrench never touches pipe or fitting surfaces. Tool comes in sizes for work with pipe from ⅛-in. to 2-in. diameters.

Brase Tool Co., 301 *Broadway, San Francisco, Calif.*

Generator Set **(36)**

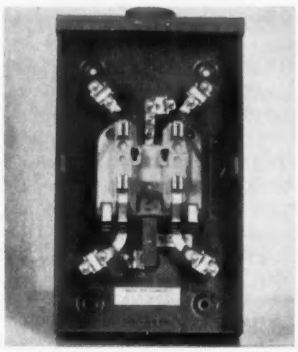
A new 1000-kw gas turbine generator set (LM175E) designed primarily for emergency back-up power generation has been announced. Its prime mover is an adaptation of the J85 aircraft jet engine. For this generating application, the J85 compressor was modified slightly; the number of stages was reduced, and a front drive shaft at the compressor end converted it to a single-shaft turboshaft engine. One of the applications for the LM175E is emergency standby power generation for telephone exchanges. A number of other applications are expected, including use in hospitals, missile bases, radar installations, airports, utility peaking, civil defense, and in other locations where loss of power could impair the public welfare.

General Electric Co., Schenectady 5, *N. Y.*

Distribution Transformer **(37)**

Introduction of its new Endur-All/65 pole-type distribution transformer in ratings from five through 500 kva designed to withstand full short-circuit has been announced. Reduced size comes from low-voltage aluminum sheet windings. Varnish-free core and coil assure improved over-all system impulse strength. Unit is designed for pole cluster-mounting. Larger clamp-type connectors are suitable for aluminum or copper cables.

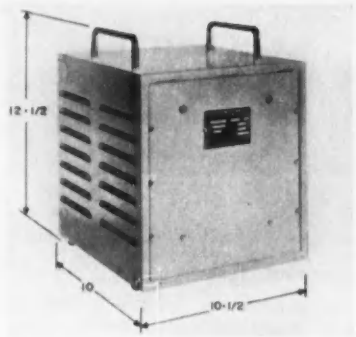
Allis-Chalmers Manufacturing Co., Milwaukee 1, *Wis.*



Meter Mounting **(38)**

A new 200-amp meter mounting has a built in by-pass that bypasses the meter so there will be no interruption of service to customer for replacement or test of meter. A twist of the wrist of the finger tab does the by-passing. When a building or residence needs service before a meter is set, the by-pass tab is turned to "up" position and a glass cover can be sealed on mounting. Meter cannot be sealed on mounting with it in by-pass position. There is ample wiring room. This same by-pass is also on 100-amp single and 100-amp gang type mountings.

Code Corp., 4566 *Baker St., Philadelphia* 27, *Pa.*



Voltage Regulator **(39)**

New solid-state, semiconductor Stabiline automatic voltage regulator, designated Type XR2500, will maintain constant output voltage regardless of line or load changes. Basic design can be adapted to other voltage, frequency and load requirements but representative ratings are: input 95-135 volts, 45-70 cycles single phase; output 115 volts nominal, 110-120 volts adjustable, 2.5 rated kva.

Superior Electric Co., Bristol, Conn.

Polarizing Panel **(40)**

A new enclosing element for fluorescent lighting fixtures, employing an improved method of polarizing light, has been announced. Panel gives 45% polarization and it is designed for standard installation in offices, stores, schools and other buildings. The panel consists of tiny glass flakes arranged in layers in a polyester plastic sheet. Panel is available in four sizes: 1 by 2 ft, 1 by 4 ft, 2 by 2 ft, and 2 by 4 ft. It fits Day-Brite's standard troffer, Mobilex and Daylume fixtures, and will be offered as an optional enclosure for these fixtures. It will also be offered for existing Day-Brite fixture installations using the above units.

Day-Brite Lighting, Inc., 6260 *N. Broadway, St. Louis* 15, *Mo.*

Pushbutton Stations **(41)**

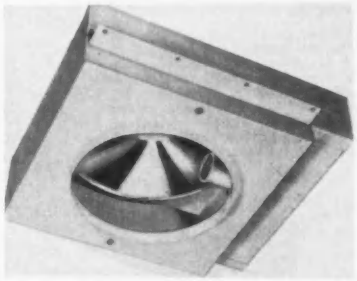
An improved series of heavy-duty electrical pushbutton stations which will replace the present D-120 and D-113 series of standard and heavy-duty models, has been introduced. The new series, designed primarily for use with magnetic motor starters, consist of a D-11 single-circuit universal model, a D-12 double-circuit universal unit, and a D-13 start-stop station. The D-11 series has a 600-volt ac maximum rating, is UL listed for heavy-duty use, and meets NEMA standards. They can also be used with low-voltage ac across-the-line magnetic starters, and reduced-voltage ac general purpose magnetic starters using 150-amp and smaller line contactors. New stations will also replace modified versions of D-113 and D-120 Series used for OFC, EGP and EWC explosion-proof pushbutton station enclosures. EFD, EFS, FS, FD, EGP, OFC and EWC pushbutton station Condulets will all be equipped with the new D-11 models.

Crouse-Hinds Co., Syracuse, N. Y.

Fittings **(42)**

New fittings for use with the latest types of jacketed interlocked cable, both jackets and non-jacketed continuous armored cable are now part of this complete standard line. Fittings are immediately available in 15 basic types both in cast aluminum as well as bronze to parallel the standard line of terminators and splicing fittings for interlocked armored cable. Literature is available.

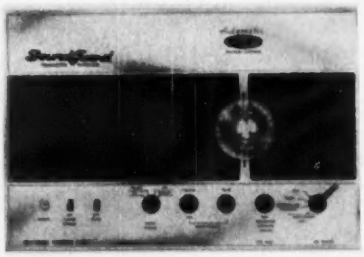
OZ Electrical Manufacturing Co., 207 Bond St., Brooklyn 17, *N. Y.*



Housings **(43)**

Heavy duty concrete power housings for 60-, 100- and 150-watt lamps are now available. Units are designed for top access to junction box for wiring before pouring and for inside access for wiring after pouring. Housings are made of 16-gauge steel that has been enameled and baked. Both prewired and unwired housings feature extra shallow depth of only 3½ in., and specially designed reflectors. Openings of from 7⅜ in. sq, 9½ in. sq and 11¾ in. by 11¾ in. sq indicate range of housings for 60- to 150-watt lamps. A variety of trim frames and glass enclosures of opal, fresnel and louvered are available. Literature is available.

Markstone Mfg. Co., 1531 *North Kingsbury St., Chicago* 22, *Ill.*



Intercom System (44)

A completely transistorized intercommunications system combined with AM-FM radio is now available for both home and office with the sound guard director, Model SG-8407. System includes: master station, three indoor remote stations, and one outdoor remote station. Like all Sound Guard Radio Intercoms, the Director requires the SG-8400 recess installation kit consisting of housings, wire and mounting brackets.

Progress Webster Corp., Rochester 21, *N. Y.*

Heating Units (45)

A new line of electric infrared heating units has been introduced. They are designed for indoor or outdoor use. Objects are heated directly by infrared rays. Some of the areas with large air movements that might use infrared units would be: airplane hangars; airport, railroad and bus terminals; building entrances, marquees and vestibules; drive-in establishments; garages and service stations; grandstands; loading platforms; maintenance shops; patios and outdoor cafes; swimming pools; and transit platforms. Literature is available.

Ilg Electric Ventilating Co., 2850 *North Pulaski Road, Chicago* 41, *Ill.*

Drills (46)

A new line of heavy-duty ½ in. all-purpose drills that has the compactness of ¼ in. units and advantages of right-angle drilling, plus power, torque and speeds to handle general and specialized heavy-duty jobs, has been introduced. Drill is also 3⅜ in. wide and fits into narrow places. For awkward, close-quarter jobs, spade handle is removable. Model No. 723 is a reversing drill for safely backing out of tight spots or heavy timbers, especially when operator is in a precarious position.

Stanley Power Tools, division of Stanley Works, 195 *Lake St., New Britain, Conn.*

Motor-Alternator Set (47)

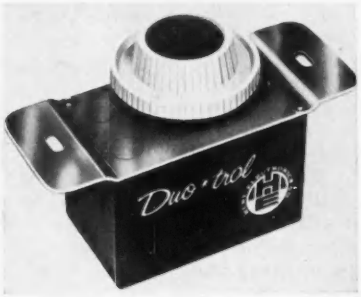
A portable motor-alternator set that plugs into any standard 115-volt outlet and converts 115-volt, 60-cycle, single-phase power to 400-cycle, single- or 3-phase power is available. Basically designed for powering or testing 400-cycle equipment, output may be rectified for use on dc equipment. Set consists of a ½-hp induction drive motor and a permanent magnet 14-pole alternator.

General Electric Co., Schenectady 5, N. Y.

Transformer (48)

A new dry-type transformer with a 3-piece case, called the Atlantic "3," has been introduced. It has been designed to simplify installation. It is ideal for use at many indoor sites formerly considered unsuitable for conventional transformers. It provides an extremely reliable power supply for equipment, assembly line machinery, appliances, lighting loads and an infinite variety of low voltage applications. It is available in single phase ratings from 3 to 25 kva, Class B, 80° C rise. Literature is available.

Atlantic Transformer Co., 8330 Hegerman St., Philadelphia 36, Pa.



Light Dimmer (49)

A new light dimmer, called the Duo-Trol 600, has been introduced. Rated at 600 watts, it electronically controls all incandescent lighting fixtures from any standard wall box without special wiring or separate attachments. Duo-Trol 600 is a solid-state, full-wave proportional power control which conserves power in exact proportion to the light intensity used. One of the features is the combination tap/dial which may be tapped on and off at any pre-dialed light level. Another is the short-stroke continuous control potentiometer.

Hunt Electronics Co., 2617 Andjon Dr., Dallas 20, Texas.

Extension Saw (50)

A new hole cut extension saw is especially designed to drill, guide and cut holes for service entrance, pipe riser, through the roof overhang and pitched roof, all in one or two minute operation. Saw begins with a special automotive length (6¾ OAL) high speed steel drill which projects 2½ in. beyond and above cutting edge, for easy starting and deep pilot hole on steep pitched roofs. Coarse tooth, high speed steel deep cut saws are screwed onto the ⅝-in. stressproof alloy steel nose which is threaded ⅝-18 to receive any standard hole saw. The nose without guide tubes will clear a 1-in. hole.

Blackhawk Industries, Dubuque, Iowa

Wall Plate (51)

Duplex weatherproof wall plates feature stay-open individually hinged covers. Plate is constructed of corrosion resistant aluminum, .060 in. thick and will accommodate all types of standard flush tumbler and power outlet combinations. Covers, hinged to plate with stainless steel spring and aluminum pin, are of aluminum coated die-cast zinc and include cemented-in soft rubber gasket for weather-tite fit. Recess in covers provide clearance for switch handles in either "off" or "on" position.

Leviton Manufacturing Co., Brooklyn 22, N. Y.

Substations (52)

A redesigned line of single-circuit unit subtations has been announced. They are available from 1,000 to 7,500 kva, and include a dual-rated 55C/65C transformer and a feeder drawout power circuit breaker, with necessary auxiliary devices. New "close-coupled" design permits transformer and switchgear compartment, which is bolted to common base, to be moved separately. The change from previous "wrap-around" design makes it possible to enter switchgear compartment from either front or back.

General Electric Co., Schenectady 5, N. Y.

Temperature Element (53)

A new room temperature indicating-controlling element designed for mounting on ceiling-type aspirating grilles or diffusers is available. Mounted in aspirated air representative of room temperature, the element gives immediate electronic response for automatic control, indication or indicating control. A 3-ft flexible conduit terminating in a ½ in. connector is standard. Unit may be mounted on circular Venturi-Flo diffusers, louver face, or perforated face diffusers. Element is furnished in 1000, 500 and 33 ohm resistances.

Barber-Colman Co., Rockford, Ill.

Product Briefs

(54) Utility Body Co., Oakland, Calif., has introduced a new Series E enclosed superstructure **truck body** with a new weatherproof telescopic steel roof.

(55) General Electric Co., Wiring Device Dept., Providence, R. I., has introduced a redesigned FS-400 "Watch Dog" **starter** employing a new metal glow switch. . . . (56) A lightweight ½-in., pistol-type **drill,** designed for heavy-duty industrial and construction work, has been introduced by Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.

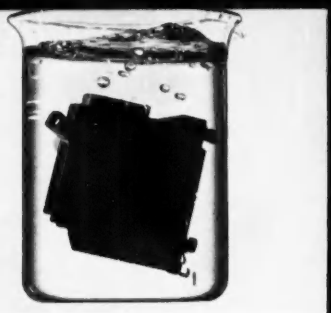
(57) Skil Corp., Chicago, Ill., has announced a new heavy-duty, ⅜-in. electric **drill,** Model 262, which has a 4-amp motor, all ball and needle bearing construction and a lightweight die-cast aluminum housing. . . . (58) New compact "handy" **boxes** manufactured to oiltight JIC standards are now available from Keystone Mfg. Co., Warren, Mich.

(59) NuTone, Inc., Cincinnati, Ohio, announces new wall **fans** available with all-aluminum exterior parts. . . . (60) Bi-Cast TD-2 epoxy **compound kits** for splicing, terminating and repairing of paper-lead cables are now available from the Bishop Mfg. Corp., Cedar Grove, N. J.

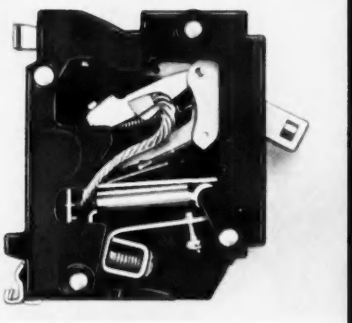
(61) Thomas & Betts Co., Inc., Elizabeth, N. J., has added a new ½-in. diameter pre-insulated service entrance **splicer** to their line of insulated and non-insulated service entrance splicers for residential and commercial installations up to No. 1/0 conductor.

(62) New Porter-Cable "Kango" L, K and M type electric **hammers** designed for all kinds of industrial, commercial and building construction uses, have been introduced by Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.


WHAT A BEAUTIFUL WAY TO SHOW HOW GOOD YOUR WIRING JOB IS



WON'T RUST, WON'T CORRODE. Every operating part is either stainless steel or heavily plated for rust and corrosion resistance.



DOUBLE PROTECTION. Both magnetic trip for short circuits and a bimetal trip for sustained overloads.

Looks so much better, installs so much easier . . .

Cutler-Hammer's NEW Safetybreaker*

. . . far ahead in every way

Here's a bonus in beauty and protection that gives you—and your homeowner customer—many exclusive features at *no extra cost.*

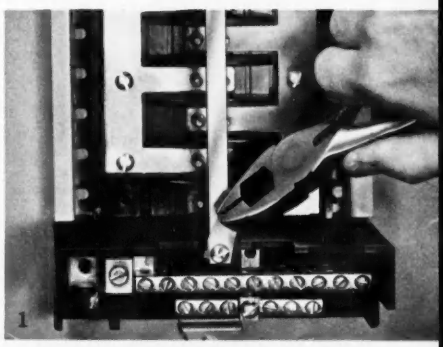
Why install the old-fashioned "basement gray" box when this modern appliance styling is available for the same—often lower—price?

Simplest, most foolproof non-interchangeability system by far

Safetybreaker's simplified non-interchangeability is as far ahead of competition as its styling. There's no fussy keying system. No special tools or "can openers" are required. It's impossible to break off or incorrectly position tabs. See your Cutler-Hammer distributor for a 60-second demonstration. Try it. Prove to yourself how much better, how much easier to install the Safetybreaker is.

Here's how the simple "up-down" N. I. system works:

1. Tear off plastic spacers to loosen locking bar screws, and let locking bar drop.
2. Plug in breakers in top portion of panel. Slide bar to top of panel.
3. Plug in remaining breakers. Tighten two special screws to lock the N. I. system. That's all there is to it!



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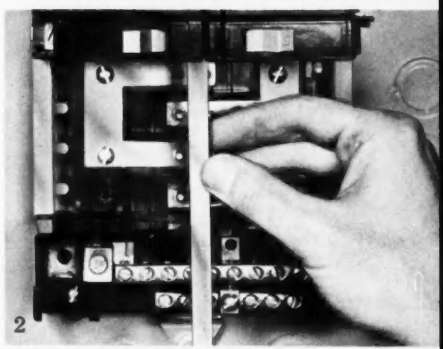

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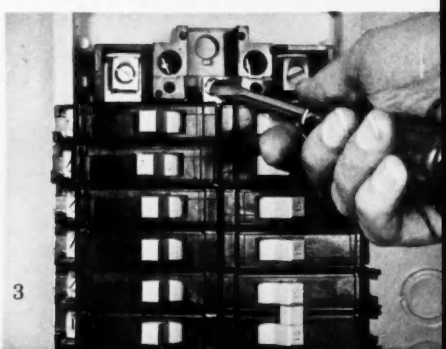


3

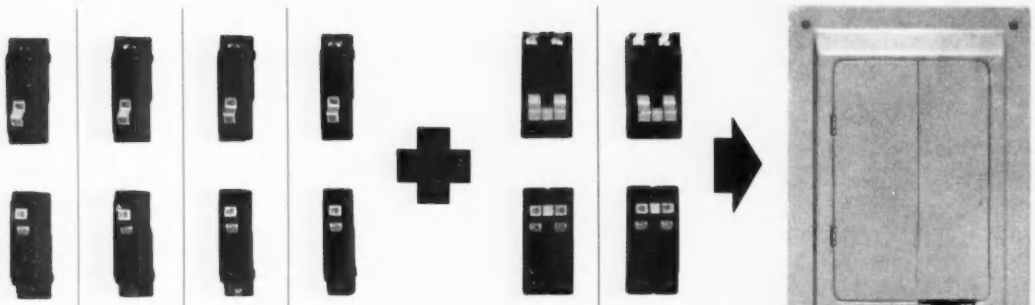
CONTROL

CUTLER-HAMMER

*Cutler-Hammer Trademark

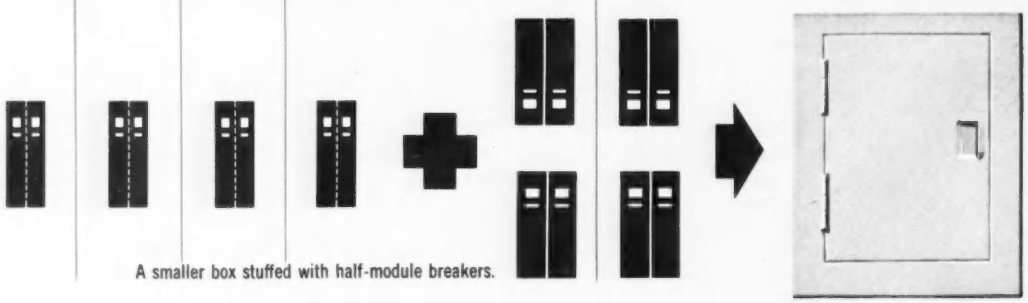
CONTROL
CUTLER HAMMER

CUTLER-HAMMER'S FULL SIZE SAFETYBREAKER IS COMPETITIVE WITH "MIDGET" BREAKERS



A full-size installation of generously designed Cutler-Hammer Safetybreakers.

$70.30 LIST



A smaller box stuffed with half-module breakers.

$70.30 LIST

GREATER VALUE FOR THE MONEY

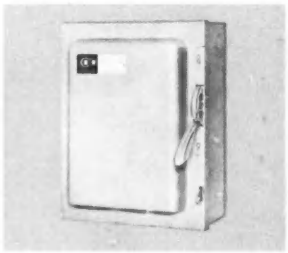
Contractors who use SAFETYBREAKERS know that:

they can provide their customers with FULL SIZE SAFETY-BREAKER protection and value for no more . . . often less, than other contractors pay for half-size installations.

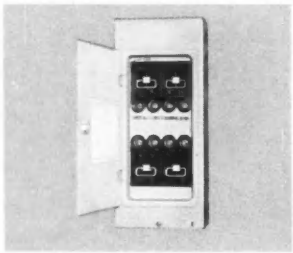
Cost aside, it's a fact that more and more electrical inspectors are insisting upon the use of only FULL SIZE circuit breakers. Their reason . . . FULL SIZE SAFETY BREAKERS don't offer an opportunity to violate local and national safety codes. Several cities have already outlawed half-size breakers and the number is growing.

Take another look at the actual example illustrated above. Then take a look at the handsome styling, the superior ease of installation, the advanced protection you get with Cutler-Hammer Safety-breakers. The man to see is your Cutler-Hammer distributor.

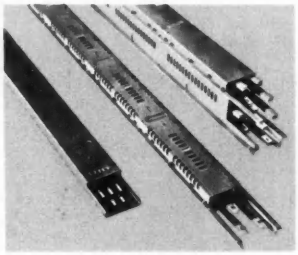
For top performance . . . these other Cutler-Hammer products



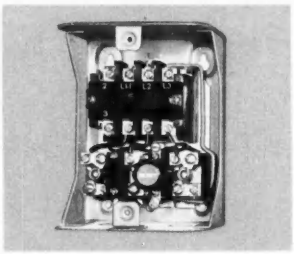
Safety Switches



Fusible Entrance Equipment



A complete line of bus-duct



General purpose motor control

WHAT'S NEW AND BETTER? ASK . . .

CUTLER-HAMMER

Cutler-Hammer Inc., Milwaukee, Wisconsin • Divisions: AIL; Mullenbach • Subsidiaries: Uni-Bus., Inc.; Cutler-Hammer International, C.A. • Associates: Cutler-Hammer Canada, Ltd.: Cutler-Hammer, Mexicana, S.A.

CONTROL

Catalogs & Bulletins

(63) TOOL WIRE. Bulletin 2152 describes new Okoseal 200 industrial and machine tool wire, a flame-resistant polyvinyl-chloride (PVC) insulated, single conductor wire rated at 600 volts. Okonite Co.

(64) MOTORS. Bulletin 420.4, fifth in a series of bulletins and specification sheets, covers ac special application motors for lightweight tools, commercial appliances, and business machines. Large Motor Div., Robbins & Myers, Inc.

(65) HEAT PUMP instruction brochure contains suggestions on the removal and installation of refrigeration valves, as well as procedures of determining operational difficulties. Chatleff Controls, Inc.

(66) INTERCOM. Brochure introduces the sound guard director, a transistorized intercom with AM-FM radio. Progress Webster Corp.

(67) JET PUMP MOTORS. GED-4361 discusses combination ball and sleeve bearing construction which gives new jet pump motors advantages of both bearing systems. General Electric Co.

(68) LIGHTING. Complete catalog illustrates low-voltage and standard spotlights; all types of specialty lighting adapters and accessories, including glass color filters. Lighting Services, Inc.

(69) ELECTRIC HEATING. 24-page catalog on 1962 line of permanent electric heating equipment includes descriptions on new wall heaters, ceiling heaters, baseboard units, control and snow melting equipment. Arvin Industries, Inc.

(70) MOTORS. Bulletin 10561 describes applications of torque motors and brakes, multipolar motors and 400-cycle motors for the machine tool, plastic, chemical, textile and food processing industries. B. A. Wesche Electric Co.

(71) MOTORS. 12-page Bulletin F-1856 on the U. S. uniclosed motor, Type H, contains information on new motors, including the recently released "1000" Series motors in dripproof, totally enclosed and explosion-proof designs. U. S. Electrical Motors Inc.

(72) WIRE AND CABLE. 83-page catalog describes 143 types of wire and cable. American Insulated Wire Corp.

(73) ELECTRIC FURNACE. Literature explains their ducted-air electric heating system and electric furnace line. Mueller Climatrol, Div. of Worthington.

(74) STANDBY LIGHTS. 8-page catalog describes battery-powered standby lights and a complete line of accessories. Watchmaster Div., Carpenter Mfg. Co.

(75) TRANSFORMERS. 12-page Bulletin GEA-7692 gives detailed information on the application, construction and operation of new line of single-phase pad-mounted distribution transformers for underground residential distribution systems. General Electric Co.

(76) LIGHTING. Outdoor wall and surface-mounted lighting units for commercial, industrial and residential applications are described in 8-page Bulletin WE 2-362. Art Metal Lighting Div., Wakefield Corp.

(77) ALUMINUM JOINING covering inert-gas welding, arc-welding, brazing and soldering methods is covered in 40-page illustrated manual. All-State Welding Alloys Co., Inc.

(78) TIME CONTROLS for automated electrical operation geared to a daily "on-off" scheduling are described in Bulletin 6218. Paragon Electric Co., Inc.

(79) LIGHTING. 44-page catalog presents expanded line of incandescent and fluorescent lighting fixtures designed for both residential and commercial installations. Markstone Mfg. Co.

(80) SWITCHGEAR BATTERY MAINTENANCE. An easy-to-follow formula to maintain switchgear control electric storage batteries at peak operating condition is contained in 4-page article entitled "How to Maintain Switchgear Control Batteries." Exide Industrial Marketing Div., Electric Storage Battery Co.

(81) CONNECTOR. 4-page Data Folder 6205 describes the new Rib-Grip compression connector. Jasper Blackburn Corp.

(82) AC SWITCHES. Booklet discusses design, construction, operation and application of ac switches and includes a Switch-Finder chart. Harvey Hubbell, Inc.

(83) SILICON BATTERY CHARGERS, constant current chargers, and end-cell chargers are described in 6-page Bulletin 4-100. Raytheon Co.

(84) LIGHTING. "General Lighting Design," 16-page booklet, contains basic information about the "lumen" method of lighting design, used to determine the number of lamps and fixtures required to obtain given footcandle levels in rooms of various sizes and reflectances. General Electric Co.

(85) SCHOOL LIGHTING. Brochure describes Ortho lighting system for classrooms. Gibson Mfg. Co.

(86) COMMERCIAL LIGHTING catalog and specification guide for commercial and industrial lighting fixtures describes a wide variety of decorative and functional fixtures. John C. Virden Co.

(87) TERMINAL BLOCKS, terminal strips, special connectors and accessories are described in new catalog. Rowan Controller Co.

(88) LIGHTING POLE Catalog L-7 of tapered aluminum standards for all outdoor lighting applications describes lighting for street, highway, residential, patio, pool, marinas, motels and parking lots. General Tapered Products, Inc.

(89) SUBSTATIONS. New line of pre-engineered secondary unit substations, available for 4.16, 12.0, 13.2 and 13.8 kv applications, is described in 8-page Bulletin 3110-1A. I-T-E Circuit Breaker Co.

(90) FLUORESCENT LIGHTING. Two new sizes of "Sabre" fluorescent lighting fixtures, meeting virtually all lighting requirements of schools, offices and stores, are described in 4-page brochure. Miller Co.

(91) MOTORS. New specification sheet for users of special purpose fractional hp motors covers the squirrel cage induction, ball bearing type for both conventional and explosion-proof applications. Motor Appliance Corp.

(92) INDICATOR LIGHTS. Brochure presents technical data on Dialco indicator lights designed for applications requiring lights that are completely oil-tight, water-tight and dust-tight on the face of the panel. Dialight Corp.

(93) MOTORS. 20-page Bulletin F-2055 covers the major lines, services after sale, and facilities and information on types of standard and specialized motors and allied products. U. S. Electrical Motors Inc.

(94) SILICONE VARNISHES. 6-page Brochure 07-009 entitled "Silicone Varnishes for Dipping, Impregnating" describes four varnishes for use at AIEE Classes 180 and 220 C and two for use at temperatures below Class H. Dow Corning Corp.

(95) POWER SYSTEMS. Bulletin 6639 describes circuits and characteristics of completely static systems that provide standby ac electrical power for variety of applications. Exide Industrial Marketing Div., Electric Storage Battery Co.

(96) TRANSFORMERS. Bulletin 61C9696A features "Safe/Tran" 3-phase padmounted transformers suited for apartment houses, shopping centers, schools, hotels, motels, theatres and industrial parks. Allis-Chalmers Mfg. Co.

(97) CONNECTORS. Brochure describes color-keyed compression connectors and catalogs the different sizes in five basic categories—one-hole and two-hole lugs, splices, compression taps and pigtails. Thomas & Betts Co., Inc.

(98) EXPANSION BOLT. The Wej-it method of anchoring anything to concrete and other nonfrangible materials is described in Data Sheet No. 462. Wej-it Expansion Products, Inc.

(99) MOTOR CONTROLS. 12-page catalog covers specifications of all major products including magnetic starters and contactors; reversing starters and contactors; reduced voltage and manual starters. C. and E. Automatic Products.

(100) GARDEN LIGHTING. Flower beds, trellises, fountains, pools, walkways, drives, barbeque or recreational areas can now be enjoyed by night as well as by day when illuminated with the Floralites described in brochure. Steber Div., Pyle-National Co.

(101) MOTORS. Technical Bulletin F-2030 provides ratings, dimensions, specifications and a selection guide for the various products in Syncrogear line. U. S. Electrical Motors Inc.

(102) TEST KIT. The "Mark III" conductivity test kit used to measure the conductivity of floors and other equipment in anesthetizing or other critical areas is described in Bulletin 21-752-6. James G. Biddle Co.

(103) POWER SUPPLIES. 32-page brochure describes approximately 500 models from complete line of standard Sorensen controlled power products and custom capabilities. Sorensen Products, Raytheon Co.

Hot and cold cable torture chambers...

mean better cable for you. Our aim at Circle is not just to meet specifications, but to see how far we can exceed them. This is the job of our cable testing laboratory.

High temperature aging ... sub-zero freezing ... ozone ... long-time water immersion ... and many other tests are performed continuously to assure maximum cable reliability. Add to this Circle's unmatched manufacturing experience and reputation for fast service and you'll see why Circle is the choice of so many cable users. For better cable at no extra cost specify Circle cable on your next job.

CIRCLE WIRE & CABLE CORP.

SUBSIDIARY OF **CERRO CORPORATION**

PLANTS: Maspeth and Hicksville, N. Y. **SALES OFFICES & WAREHOUSES:** In all principal cities.

Rubber Covered Wires & Cables • Varnished Cambric Cables • Plastic Insulated Cables • Neoprene Sheathed Cables • "CIRTUBE" EMT

COMPLETELY BUSSED TO GO UP QUICK!

I-T-E

METERING SYSTEMS

SAVE

UP TO 70% IN TIME

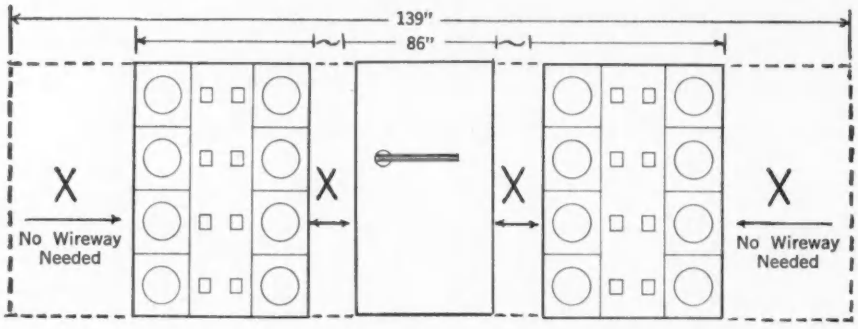
I-T-E **METERING SYSTEMS** are complete devices! I-T-E does the bussing in the factory so you don't have to wire on the job! Only two major components to connect — main disconnect and meter-breaker section. The elimination of separate wireways means faster installation and more meters in less wall space. Complete bussing also assures **lower total cost.** You merely wire in service to the main disconnect . . . and wire out distribution from the breakers.

Wall mounted meter centers are available for services through 600 Amps. Free standing island type meter centers are available for services through 2000 Amps. Installations from the smallest up to 100 **or more** meters are no problem with these superior designs.

DESCRIPTIVE BULLETIN AVAILABLE!

For additional information on famous-quality I-T-E Metering Systems, ask for Bulletin 9001 from your I-T-E Authorized Distributor, local I-T-E District Office, or write to I-T-E Circuit Breaker Company, 125 Bennett St., N. W., Atlanta 9, Ga.

for the Contractor who is Proud of his work



I-T-E CIRCUIT BREAKER COMPANY

WALKER DIVISION

Reader's Quiz

QUESTIONS from readers on problems of industrial equipment, installations, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay $5.00.

Multiple Neutral Grounding

QUESTION G41—We have recently encountered a rather interesting problem in the design of a power distribution system. We submitted to a client the design of a 3-phase, 4-wire distribution system with the neutral grounded at the transformer, but the neutral was not grounded at the individual power and lighting panels. The entire plant structural steel was bonded and adequately grounded.

However, they insisted that the neutral be grounded at every power and lighting panel.

Will someone please explain the advantages or disadvantages of the method required by our client. Further, what is the current trend in this area?—J.A.M.

ANSWER TO G41—Section 250-23 of the 1959 NEC spells out the requirements for grounding connections for alternating-current systems. The code states that no connection to a grounding electrode shall be made to the grounded circuit conductor on the load side of the service disconnecting means, except as provided for in Section 250-24 (which applies to two or more buildings supplied by a single service).

In addition, Section 250-21 states, "The grounding of wiring systems, circuits, arresters, cable armor, conduit, or other metal raceways as a protective measure shall be so arranged that there will be no objectionable passage of current over the grounding conductors. The temporary currents set up under accidental conditions, while the grounding conductors are performing their intended protective functions, are not to be considered as objectionable. . . ."

By grounding the neutral at every panelboard, the neutral currents are given three parallel paths of return to the source:

a) via the cable armor or conduit

b) via the building structural steel

c) via the neutral conductor.

Under normal conditions most of the neutral current would flow through the neutral conductor because of its much lower inductive reactance with respect to the phase legs. However, some current would also flow on the conduit or cable armor, and a small percentage would flow on the structural steel. The two latter current flows are in direct violation of Section 250-21 of the code.

If a neutral of a panelboard feeder were to become "open" or disconnected, most of the neutral current would then return via the cable armor or conduit. This path could have a sizable impedance, thereby raising the potential of the panelboard housing with respect to ground. This difference of potential would create a dangerous shock hazard. In addition, any grounded conductive object making intermittent contact with the return path of this neutral current could cause an arcing condition which would create a fire hazard.—S.L.P.

Treating Insulation Boards

QUESTION H41—In our plant, we have small power packs which generate about 8000 volts direct current for static precipitators in our air conditioning units. The tubes and other electronic components are mounted on insulating board, which lately has become conductive. Discharge between the high-voltage tube sockets and other devices and the grounded metal case is taking place and the precipitator grid does not receive the full voltage.

Is there any way to treat the insulating board to establish the original insulating value?—E.C.T.

ANSWER TO H41—Replacement of the insulating base would be the best way to repair the insulation damage caused by high-voltage leakage. The rectifier tube sockets should be checked for insulation breakdown and replaced if necessary.

Corona, a kind of high-voltage leakage that often causes permanent insulation damage in high-voltage circuits, can be eliminated by the following steps. First, the high-voltage compartment area should be cleaned to remove dust and moisture. Second, sharp-edged metallic points in the wiring and one the tube socket terminals should be removed by filing or cutting. Next, an anti-corona material should be sprayed around the corona area. As a final check, the lead dress of the high-voltage wiring should be examined for proper spacing and insulation from the grounded metal case.—K.C.

ANSWER TO H41—Disconnect the unit. Clean and inspect the insulating board. In case of arcing, the board may likely have been carbonated and must be discarded. In case of light corona, however, the board needs only cleaning. A spray of high-voltage acrylic ignition spray as used on ignition systems for cars or by TV servicemen may restore the original condition. —K.H.

Faraday Shield

QUESTION J41—What is a Faraday shield and how is it used?—J.B.K.

ANSWER TO J41—A Faraday shield is a group of parallel wires used to isolate or control the electrostatic coupling to an electrical component, such as a resistor, coil, or circuit. One end of each parallel wire is connected to a common conductor so as to form a comb-like shield. The common conductor is usually grounded. The group acts as an electrostatic shield, but has little effect on the magnetic field since there are no closed loops around which eddy currents can flow.

The Faraday shield is more commonly used in radio transmitters and electronic measurements where its properties are useful. It sometimes is used in power transformers to isolate primary and secondaries electrostatically while still permitting magnetic coupling. In this application the shield may consist of a single turn of metal foil with a suitable gap to prevent the shield from acting as a short cir-

WESTINGHOUSE ASKED:

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and modernization costs went down

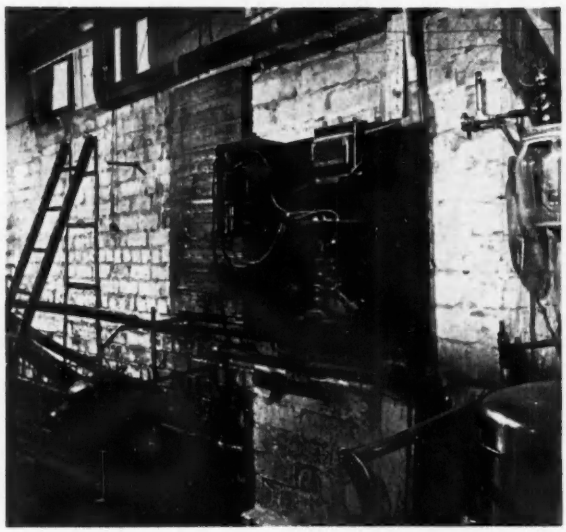
Recommendations by Westinghouse saved money for both owner and contractor on the modernization of the 250-room Seneca Hotel, Columbus, Ohio.

The 47-year-old hotel had fallen behind the times when it was bought by Seneca Realty, Inc., in April, 1961. The newspaper story caught the eye of V. J. Weisenbach of Electric Power Equipment Company. Mr. Weisenbach, who works full-time on modernization business, promptly proceeded to sell modernization beginning with central air conditioning and the electrical distribution system.

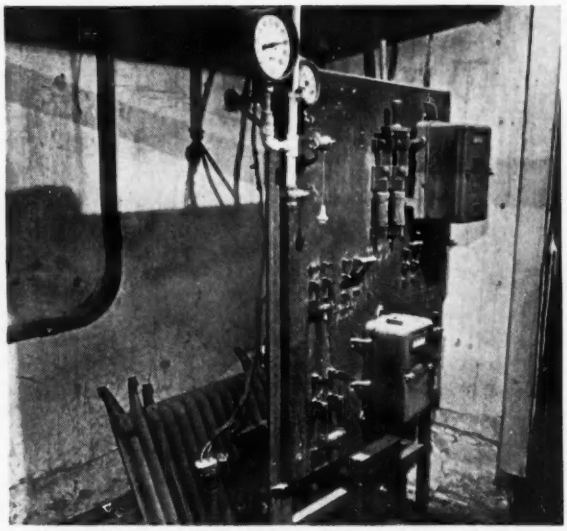
Westinghouse participated in the modernization, tailoring equipment recommendations to fit the job requirements. For example, original planning called for a 40-kw rectifier to supply power to the elevators. Westinghouse engineers analyzed the specs and suggested that a 25-kw unit would be more than adequate. On the regenerative control, tests were conducted to make sure this control was adequate for the installation.

Today, Seneca Realty, Inc., saves $25,000 in maintenance and utility cost annually as a result of the modernization.

Westinghouse

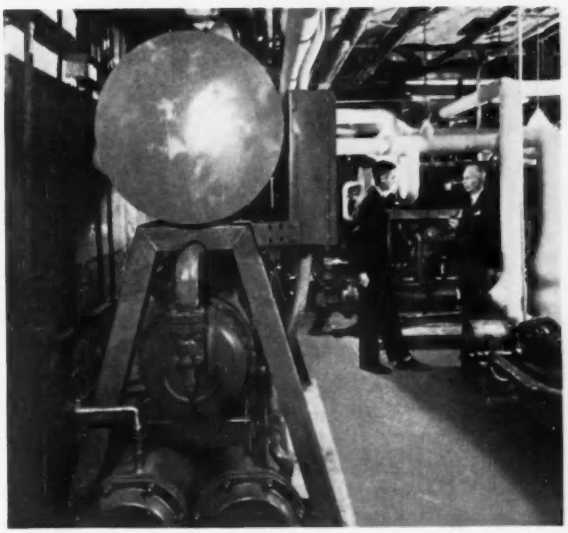


Old. Antiquated equipment in the boiler and mechanical room, before the modernization project. Almost inoperative equipment was worn, dirty, in some cases unsafe. Maintenance was extremely difficult and often costly.

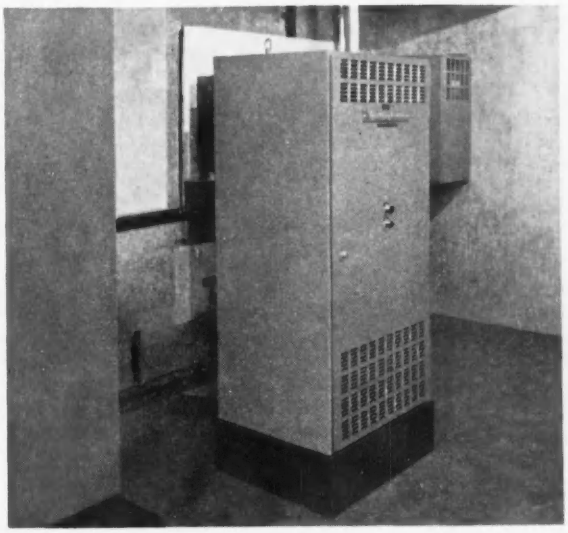


Old. The DC power for the hotel elevators was originally furnished by the utility. Switchboard open-live front was an obvious personnel hazard. Controls were susceptible to dust and dirt, requiring repeated maintenance.

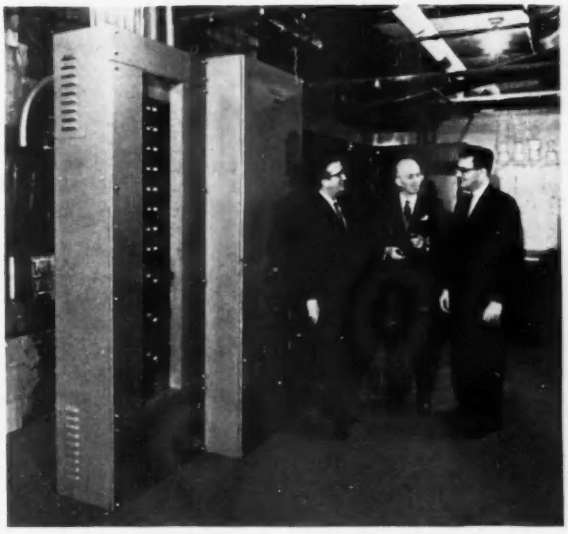
New. New Ⓦ Motor Control equipment discussed by V. J. Weisenbach, Electric Power Equipment Co., and W. B. Mann, Ⓦ Sales Engineer. Behind Mr. Mann is a new NQP Panelboard to feed lighting circuits. At right are size 1 Life Line® Starters that control pump and cooling motors.



New. Pictured are Mr. Sam Shuman, President, Julian Speer Co., Mechanical Contractor, and Herbert Tareyton, V. P., Seneca Realty, Inc. In left foreground is Ⓦ PKB packaged water chiller providing air conditioning for every room of the Seneca Hotel. The unit is provided with a complete control panel, factory-wired and ready for connection. Large hotel guest room closets house Ⓦ Series 1601 Air Distributing units, manufactured by the Sturtevant Division of Westinghouse.



New. With local utility discontinuing DC service, the economical answer was this Ⓦ 25-kw Silicon Rectifier furnishing Seneca elevators with DC power. The compact, fan-cooled unit is a maintenance-free static device. Regulation and control are automatic. The panel mounted on the wall behind the unit controls regenerative power for down elevators.



New. Messrs. Weisenbach, Tareyton and Mann stand alongside the new Ⓦ Building-type Switchboard which handles incoming 120/208V power. This Series I Switchboard houses all protective devices in one dead front streamlined enclosure. The Distribution section feeds and protects auxiliary circuits in the equipment room. J-94191

cuited turn. In the case of power applications it reduces the transmission of line transients or radio frequency noise from one circuit to another.—J.C.B.

ANSWER TO J41—A Faraday shield is used in conjunction with radio-frequency (rf) circuits. It is usually used where the rf is coupled between two circuits by means of air-wound transformers. The Faraday shield consists of a series of closely spaced parallel wires connected together on one end only and returned to ground. The shield is interposed between the two magnetic circuits to block or control capacitance coupling between windings. This helps to lower harmonic frequency transfer.

In power transformers electrostatic shields are used to reduce the coupling of noise impulses between the primary and secondary windings. The shields also help to reduce the build up of high internal static voltages.—J.L.C.

ANSWER TO J41—A Faraday shield allows a magnetic field to pass through without interference, but blocks an electrostatic field. When it is placed between the primary and secondary windings of a tuned radio-frequency (rf) transformer, it reduces the electrostatic capacitance coupling between the windings but does not affect the inductive coupling. This improves the interference-rejecting ability of the circuit.

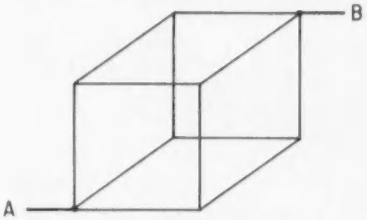
A Faraday shield is usually made by arranging a number of straight wires in a parallel and compact order on the flat surface of a square or rectangular mounting base. The base material can be paper or other thin insulation. Adjacent wires are insulated except for a common ground connection on one side of the base. Insulating varnish is used to attach the wires to the base.

On one side, a perpendicular wire is used as a common ground connection for the ends of the parallel wires. On the opposite side, the ends are left open. This arrangement prevents the formation of closed loops that would lower the Q of the shielded inductances.

One example of the use of a Faraday shield is in the design of a metal detector probe. If the probe, which contains the tank coil of an oscillator, is enclosed in a Faraday shield, the external capacitance effects produced by non-metallic objects will be eliminated, and the metal detector will respond only to metallic objects.—K.C.

Can You Answer These QUESTIONS?

QUESTION S41—Note the accompanying drawing of a cube where each of the 12 line segments represents a 1-ohm resistor. What would



the resistance be across A and B, and what formula would be used to find the answer?—R.S.

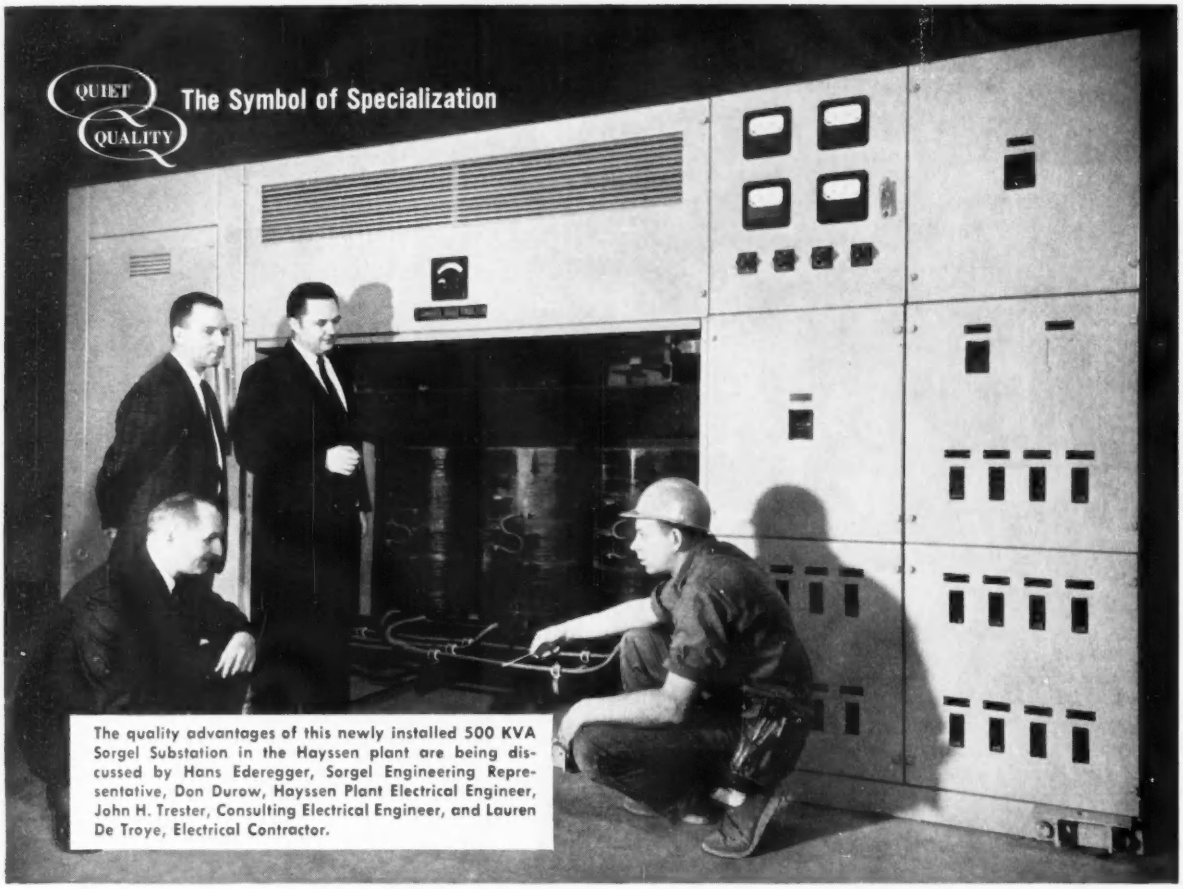
QUESTION T41—We have a problem where our conduit runs to two air conditioners seem to get hot for no apparent reason. The building is served by 3-phase, 4-wire, 120/240 volts delta. The condensers are 3-phase, 230-volt, FL amps 28 on compressors, 2.8 on fans. We have three No. 8 TW wires in ¾-in. EMT to each unit with proper fittings made up tight. Length of runs are approximately 75 ft, with about 35 ft concealed above suspended ceiling and wood deck and joist construction. Clamp-on ammeter readings at both ends check out 30 amps (L1), 30 amps (L2), and 28 amps (L3). Voltage reads 238 volts. The wires in the disconnect switches at either end feel normal to the touch. I say the wire is large enough for the load and length of these feeders. Is this slightly higher voltage causing our trouble? Are we complying with Section 430-22 of the code?

We will replace the No. 8s with No. 6s in 1-in. conduit but would like your explanation on what we have overlooked.—J.N.

QUESTION U41—I am working on a project to be built in Germany. In the specification, the required lighting intensities are given in "Lux" and I would like to find out the equivalent footcandles. I searched for the conversion factor in many handbooks but cannot find it.

I would appreciate getting this information and finding out the basis of the unit "Lux."—J.A.

PLEASE SEND IN YOUR ANSWERS BY SEPTEMBER 15



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Code Forum

Answered by:

J. C. HEWITT, *Chief Electrical Inspector, Department of Labor and Industries, State of Washington, Olympia, Wash.*

R. L. LLOYD, *Electrical Safety Engineer, National Bureau of Standards, Washington, D. C.*

B. Z. SEGALL, *Consulting Electrical Engineer, New Orleans, La.*

R. E. WARD, *Chief Electrical Inspector, Insurance Department, State of Tennessee, Nashville, Tenn.*

READERS are invited to submit questions regarding the National Electrical Code and its practical application to this Department. Questions are answered by the consulting editor whose initials appear at the end of each item. The views and opinions expressed are, in each instance, those of the individual consultant replying and are not necessarily those of his employers, of this publication or of a Code-making committee or panel on which he may serve in an official capacity.

Well Casing as Grounding Electrode

Q. *Is it the intent of Section* 250-81 *of the code that a metallic well casing more than* 10 *ft long connected to a non-metallic (plastic) piping system be considered as a grounding electrode without other grounding electrodes? — A.G.T.*

A. For our readers' convenience, Section 250-81 is quoted as follows:

"Water Pipe. A metallic underground water piping system, either local or supplying a community, shall always be used as the grounding electrode where such a piping system is available. Where the buried portion of the metallic piping system is less than 10 ft (including well casings bonded to the piping system) or there is some likelihood of the piping system being disconnected, it shall be supplemented by one or more of the grounding electrodes recognized in Section 250-82 and 250-83."

You will note the only mention of well casings is in the parenthetical clause, and this states "bonded to the piping system." The emphasis in the entire section is on a *metallic* underground water piping system. Therefore, in my opinion it is not the intent of the code that the well casing alone could constitute the grounding electrode. There is certainly a likelihood that the grounding connection would be disconnected from the pump housing or well casing where it is necessary that the well casing be pulled for repairing or replacement.

The metallic well casing could certainly be used as a supplementary ground. However, in many instances local conditions would govern whether or not such would be practical. Several factors are: the distance from the electric service to the pump location; grounding practices of the supplying utility; lightning protection; type of pump to be used—above ground or submersible. In fact, the electrical contractor should make tests to determine whether or not effective grounding has been accomplished regardless of the number or material of the electrodes used.—R.E.W.

Air Conditioning and Electric Heating

Q. *A single* 20-*amp* 240-*volt single-phase circuit supplies a* 14-*amp air conditioning unit and* 3.8 *kw of electric strip heaters in a single room. Is it the intent of the code to utilize a single branch circuit in this manner?—H.M.*

A. It is simply a matter of common sense as to the code application for this problem.

Electric strip heaters are used in many ways and combinations with air conditioning units. If each is to perform a separate function at a separate time and not simultaneously, then one circuit may be sufficient. A 3.8 kw load at 240 volts will require about 16 amps. The protective device for the air conditioning would be sufficient for this load. Some inspectors may require some definite means to assure that both units could not operate simultaneously, for example a double-throw switch, relay, interlocking contacts, etc.

In the case of some heat pumps, the air conditioning unit and the heater strips are required to operate simultaneously. In this case the single circuit would be a more practical installation. However, there is the problem of giving proper protection to each individual unit as well. Some packaged units have such a combination and have UL listing for installation on a single circuit.

It is, therefore, the intent of the code to properly protect each individual appliance without interfering with the approved and proper and normal operation of these individual appliances. This may require a single circuit, or it may require several circuits. It all depends on what is required by the system.—B.Z.S.

Number of Conductors in Wireways and Gutters

Q. *Previous to the* 1959 *edition of the National Electrical Code, the number of conductors allowed in conduit, wireways and auxiliary gutters was limited. The* 1959 *code more or less removed the number of conductors that may be installed in a raceway or cable when the current-carrying capacity of the conductors is reduced as given in Note* 8 *of Section* 310-11. *Section* 362-5 *of the* 1959 *code limits the number of conductors in a wireway to* 30 *with certain exceptions. Section* 374-5 *limits the number of conductors in auxiliary gutters the same as Section* 362-5 *for wireways.*

By reducing the current-carrying capacity of conductors in wireways or auxiliary gutters, will the code permit more than 30 *conductors?—J.B.S.*

A. No, unless such conductors are used for the purpose of signaling circuits or control conductors between a motor and its starter and used only for starting duty. You will note the last line in both Sections 362-5 and 374-5 states: "The correction factors specified in Note 8 of Tables 310-12 and 310-14 are not applicable to the foregoing."

The proposed amendments to the 1959 edition of the NEC contained a proposal that would have changed the number of conductors allowable in wireways. The proposal was in the form of a table that would

have more or less allowed an unlimited number of conductors in a wireway if such wireway was large enough. This proposal was unanimously rejected with the code panel comment as follows:

"The present provisions were retained in the code after careful consideration at the time of the 1959 revision following review of the general fact-finding report on heating and fill of raceway. No substantiating reason has been submitted to consider a revision."—R.E.W.

Fuse Reducers

Q. *Paragraph 240-23(b). Is it permissible to install a fuse reducer for cartridge fuses in a pull-out type fuseholder, such as in conventional service equipment, to permit 30-amp fuses in a 60-amp fuse gap with permanently attaching the reducer by solder or otherwise?—F.M.*

A. This section does not require the fuse reducer to be permanently attached. If approved fuse reducers have been permitted for any specific installation, it is only required that they be installed in accordance with the approved method submitted by the manufacturer. In general, this does not require solder or other such permanent attaching method.—B.Z.S.

Overcurrent Protection for Panelboards

Q. *We have a school building that requires service equipment of 800-amp capacity. Adjacent to the 800-amp main service switch there will be two panels—one panel being rated at 800 amps that will be used as the main distribution panel for motors and panel feeders; the other panel will be a 200-amp panel with overcurrent protection for several small motors and spares for future additions. Does the code require the 200-amp panel to have overcurrent protection other than the 800-amp main switch?—W.C.*

A. Your question is answered in Sections 384-14 and 384-16. Section 384-14 defines a lighting and appliance branch-circuit panelboard, and states that it is one having more than 10% of its overcurrent devices rated 30 amps or less, for which neutral connections are provided. Section 384-16 states in part that a lighting and appliance branch-circuit panelboard supplied by conductors having overcurrent protection greater than 200 amps shall be protected on the supply side by overcurrent devices having a rating not greater than that of the panelboard.

Therefore, if the 200-amp panelboard is a lighting and appliance branch-circuit panelboard, as defined by Section 384-14, such panelboard will require the overcurrent protection as specified in Section 384-16.—R.E.W.

Installation of UF Cable

Q. *When using single-conductor underground feeder cable buried directly in the earth, will the code allow such conductors of the same circuit to be buried in separate trenches?*

Will the code allow the conductors to be in the same trench with water piping or other conductors such as is used for communication circuits?—A.B.H.

A. In answer to your first question Paragraph 339-3(b), which pertains to underground feeder and branch-circuit cable, states: "Where single-conductor cables are installed, all cables of the feeder circuit, sub-feeder circuit, or branch circuit, including the neutral conductor, if any, shall be run together in the same trench or raceway." Therefore, the code would prohibit an installation as outlined in your first question.

In answer to your second question, the code does not either approve or disapprove the installation of underground feeders in the same trench with water piping. Certain clearances are required under certain conditions for communication circuits from light or power conductors. Voltage would enter into the distance required in most installations, as well as other conditions concerning the installation. Due to the fact that there is a likelihood of maintenance work having to be done on any piping system or any installation, I certainly would not recommend the placing of underground feeder cable with other material such as you mention unless supplementary protection was provided for the underground feeder, separating it from water piping, etc., and my requirements would be based on Paragraph 339-

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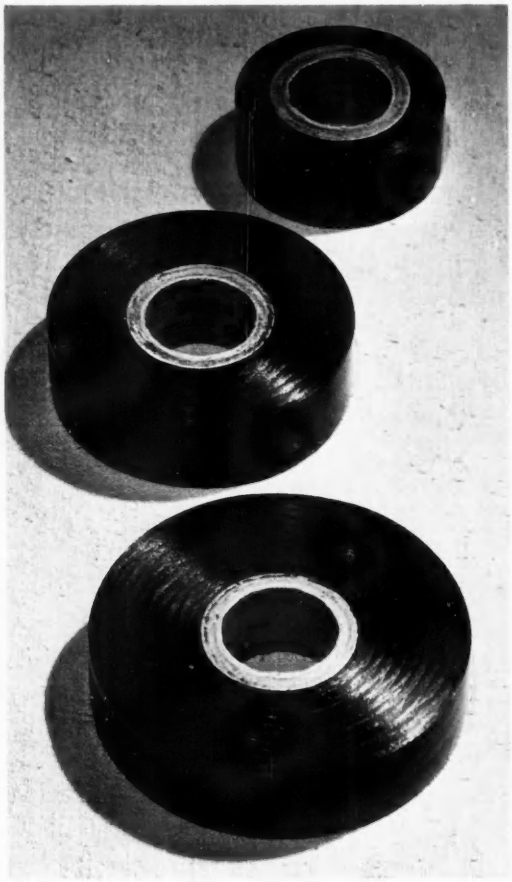

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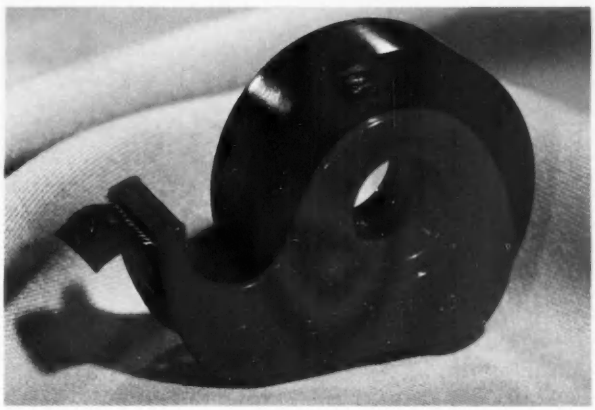

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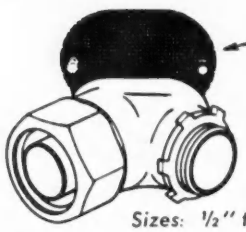

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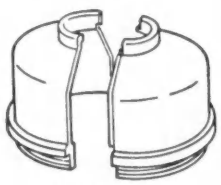
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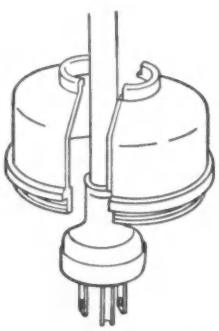

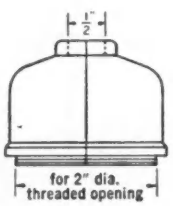

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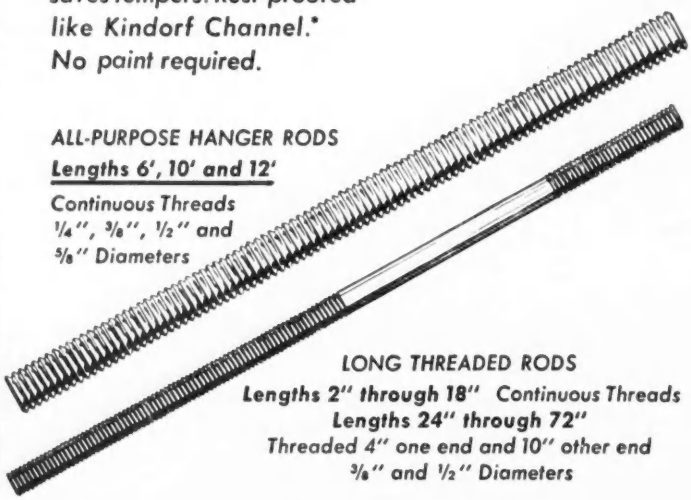

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3(c) which states: "Where buried directly in the earth, supplementary mechanical protection, such as a covering board, concrete pad, raceway, etc. when considered necessary, **may** be required by the authority enforcing the code." — R.E.W.

Series Lighting System

Q. *Does the code permit the installation of an ungrounded 480-volt series lighting system which is to be run overhead on a college campus? What code sections are applicable? What about the same question with the voltage exceeding 600 volts?—M.S.*

A. Yes. There is nothing in Article 730 that specifically prohibits such a system.

All the sections of Article 730 of course apply and particularly the additional articles as outlined in Section 730-2.

As indicated in Section 730-2, Article 710 shall be applied for the additional requirements for circuits, etc., operating at more than 600 volts.—B.Z.S.

Receptacles for Cooking Appliances

Q. *In a large tract development we plan to provide a 50-amp No. 6 branch circuit for one wall-mounted oven (4 kw) and one counter-mounted cooking unit (6 kw) in each residence. The builder wants us to install receptacles at each oven and cooking unit. What size receptacles would be required at each appliance?—B.H.*

A. While Paragraph 210-24 (c) permits a 50-amp branch circuit to serve two or more fixed cooking appliances, Paragraph 210-21 (b) requires that receptacles installed on 50-amp circuits of two or more outlets shall be rated at 50 amps. As a result, the receptacles for your 4-kw ovens and 6-kw cook tops must be of the 50-amp rating. In addition, the leads to each unit must be sized according to the appliance nameplate rating with minimum tap and cord sizes as given in Table 210-25 and Exception No. 3 of Section 240-5. And in case 3-pole receptacles are used to provide the grounding of the units to the neutral, as permitted in Section 250-60, the size of the neutral conductor cannot be less than No. 10. And finally the plug and receptacle combinations are not considered as the disconnecting means for the appliances in question and must be approved for the temperature of the space in which they are installed (see paragraph (b) of Section 422-13).

Unless there is a special need for the receptacles, it would seem to be more practical and economical to wire the units direct, using a single 50-amp branch circuit or two smaller branch circuits.—J.C.H.

Dining Area

Q. *In some dwelling occupancies the blue prints do not show a dining area and call the area next to the kitchen a family room. The kitchen is too small to have a table for eating and, therefore, have only two outlets on one 20-amp circuit. Does this satisfy Paragraph 220-3(b)?—G.B.T.*

A. No. The eating habits of America have been revolutionized. What with outdoor barbecues, television dining, midnight snacks, etc., we may say that the entire dwelling occupancy is a dining area.

These family areas are definitely eating areas. Much entertainment is done in this area and their use has built up the electrical utilization of dining-type appliances such as coffee makers, toasters, hot plates, broilers, fryers, etc. In my opinion the entire family room, or den, or recreation room or rumpus room, or whatever you may want to call it, is a giant kitchen dining area and should be so treated.

It is interesting to note that the proposed 1962 Code is doing something about this single branch circuit in the kitchen. A new proposed requirement in Paragraph 220-3(b) states:

"Receptacle outlets supplied by at least two appliance receptacle branch circuits shall be installed in the kitchen."—B.Z.S.

Electric Heaters On 30-Amp Circuits

Q. *Is it permissible to connect electric baseboard heaters on 30-amp branch circuits in residential occupancies? The heaters are*

rated from 1.5 to 4 kw, and we propose to group them on 230-volt, 2-wire 30-amp circuits so that the total load on each circuit will not exceed 5500 watts. The heaters are permanently connected.—A.J.B.

A. Paragraph 210-24 (b) of the 1959 NEC states, in part, that appliances in any occupancy may be connected to 30-amp branch circuits having two or more outlets. And to pursue this a bit further, the definition of an "appliance" in Article 100 includes heating equipment in the examples cited.

Since you state the total heater load on each 30-amp circuit will not exceed 5500 watts, this means that each branch circuit will not exceed 24 amps (5500/230). In effect, the maximum loading would not exceed 80% on any 30-amp circuit, which signifies good design practice. By derating the load on each circuit, this will take care of possible increases in current due to voltage surges in the utility supply.

Table 210-25 summarizes branch-circuit requirements for sizes of circuit wires, taps, overcurrent devices, etc. in connection with 30-amp circuits.—J.C.H.

Grounding Fixed Equipment

Q. *Under Section 250-42, Grounding of Fixed Equipment, it is stated: "Under any of the following conditions, exposed, non-current-carrying metal parts of fixed equipment, which are liable to become energized, shall be grounded . . ."*

Can metal housings of fixed equipment, which are exposed, containing conductors approved for the purpose with connections made according to code requirements be classed as non-current-carrying metal parts that are not liable to become energized? In other words, can insulation of conductors and splices be accepted as guaranteeing housings not to become energized? —B.W.

A. No, such equipment would require grounding if required by Article 250 of the code. Generally speaking, decorative metal parts, where grounding is impractical and where such metal parts are so located with respect to live parts that it is a very remote possibility they would ever become energized, would be an example of metal classed as not liable to become energized.

Your question calls to mind three investigations of deaths by electrocution that I have made. Two were caused by outlet box screws penetrating taped connections where a non-metallic system of wiring had been used with metal boxes. The other was apparently caused by a surge of lightning rupturing a taped connection of a circuit conductor in an electric range welding the conductor to the frame of the range. The frame of the range was not grounded, and from the physical evidence of the connection the condition had existed for probably several years. On one of the junction box accidents such could have existed for ten years as the installation was ten years old. Needless to say, grounding of the boxes had not been done in either case.—R.E.W.

Type SE Cable

Q. *Is it permissible to use Type SE Cable with the "covered" neutral to feed a sub-panel within the same building?—J.D.G.*

A. No. The 1962 proposed revisions are attempting to clarify this matter. The following abstract from proposed Paragraph 338-3(b) indicates a more definite language than does the present code wording:

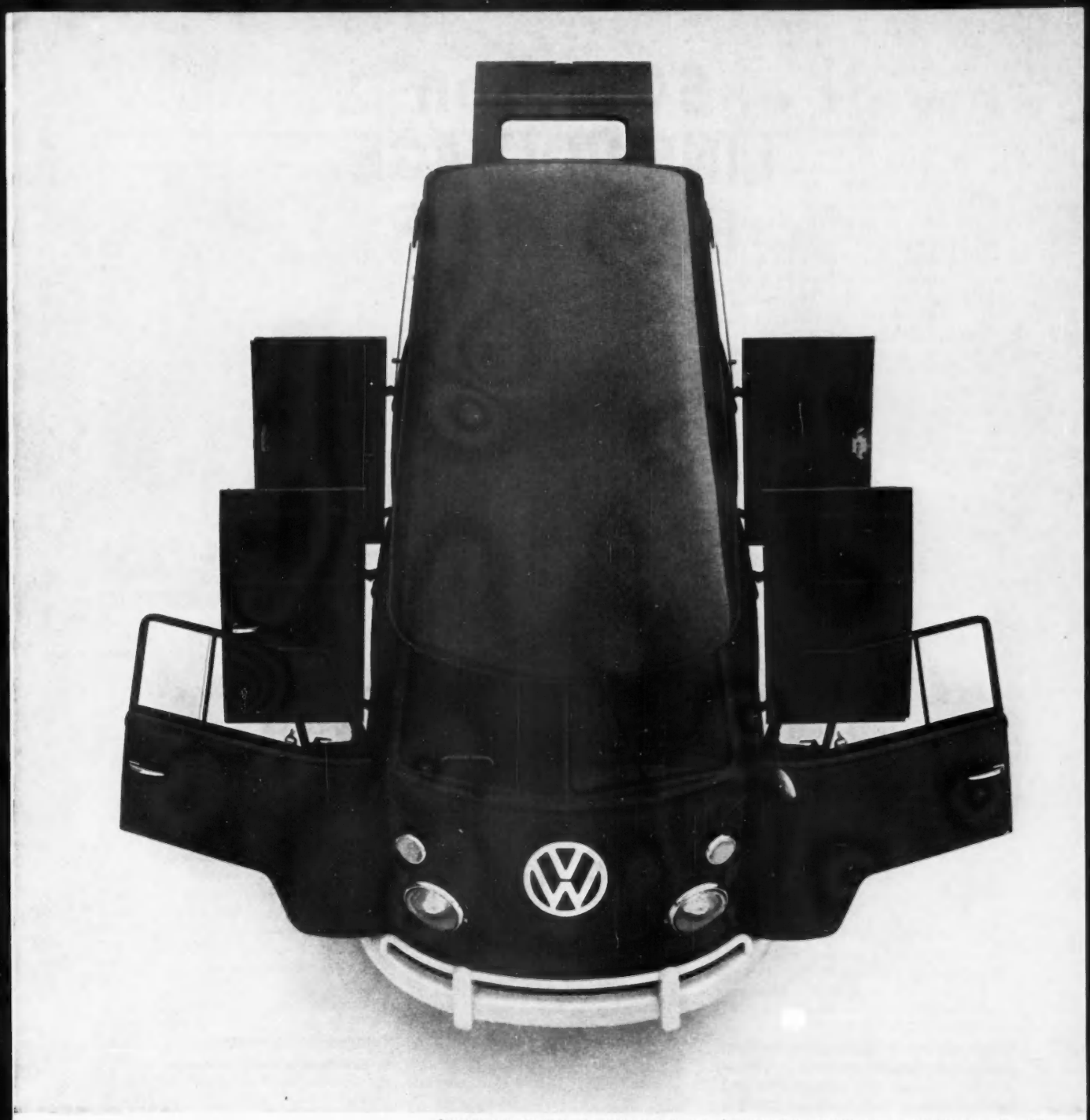
"Service-entrance cables without individual insulation on the grounded circuit conductor SHALL NOT BE USED AS A BRANCH CIRCUIT OR AS A FEEDER WITHIN A BUILDING, except a cable which has a final non-metallic outer covering and when supplied by alternating current not exceeding 150 volts to ground, may be used . . . or (2) AS A FEEDER TO SUPPLY ONLY OTHER BUILDINGS ON THE SAME PREMISES. IT SHALL NOT BE USED AS A FEEDER TERMINATING WITHIN THE SAME BUILDING IN WHICH IT ORIGINATES."

Note: The capitalizations are by the writer and indicate the new proposed 1962 wording.

It is of interest to point out, furthermore, that the supporting comments of the panel has this statement:

"Also, where used as a feeder to supply another building on the premises the cable should terminate on the exterior of such building."

This recommendation is not included in the proposed 1962 revisions but it is of interest since it brings out the further intent of this requirement.—B.Z.S.



 *SUGGESTED RETAIL PRICE. †SUGGESTED PRICE, EAST COAST P.O.E. PLUS TRANSPORT, LOCAL COSTS, TAXES.

1 door, 2 doors, 3 doors, 4 doors, 5 doors, 6 do

No blind spots.

You don't have to wait until the guy behind you leaves to open a door.

You don't have to stand in the slush in the gutter to load.

Or climb inside, either.

Or take everything out to get at something in front.

Or lift heavy stuff a couple of feet up from the street.

The Volkswagen's side doorways are only a few inches up from the sidewalk.

And they're almost 4 feet wide. Cockeyed sizes and shapes are easy to get in.

You can reach almost everything from the sidewalk.

Either sidewalk.

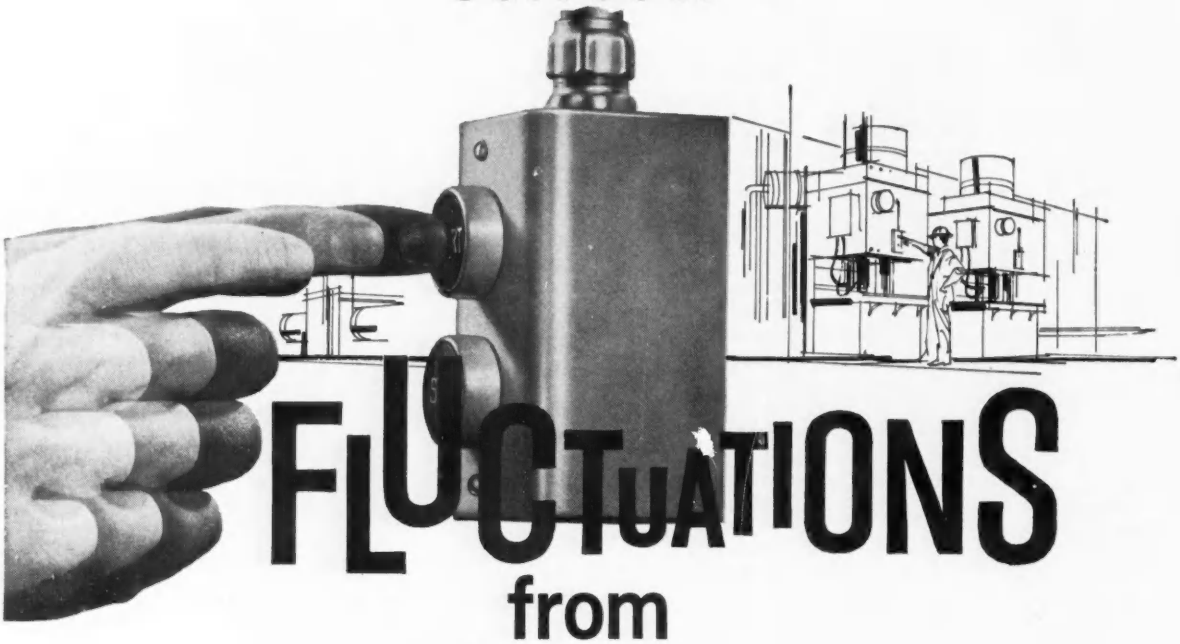
There's just one thing. The double doors on the driver's side are extra. $80.*

But the rest of the truck sells for only $1895.†

You could buy the extra doorway first.

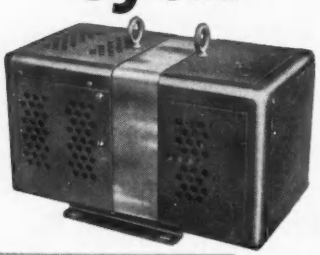
And add the truck later.

SOLAtron LINE VOLTAGE REGULATOR corrects



FLUCTUATIONS from the very first cycle

Responds up to 10 times faster than electromechanical devices . . . irons out fluctuations due to both line and load changes! Voltage correction is practically *concurrent* with every disturbance; starts long before output voltage nears the boundaries of the regulation envelope. Even under extreme conditions, correction never takes more than one-sixth second. And *talk about reliability!* Solatron line voltage regulators eliminate moving parts; rule out mechanical wear and tear. Complete maintenance-free operation. Solid-state sensor monitors actual output . . . then regulates the transformer *flux* to automatically maintain correct nominal voltage.



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Superior performance — regulation ±1% for line and load variations, zero to full load.

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"Lifeguard circuitry" — withstands momentary overloads many times rated current.

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Smaller, lighter—considerably more compact than other standard regulators.

Solatron line voltage regulators are offered in ratings from 3 to 100 kva, for 120 and 240 vac, 60 and 400 cycles. For more information contact your local Sola distributor or call us direct.

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In the News

John C. Hewitt New Consulting Code Editor

John C. Hewitt, chief electrical inspector of the State of Washington, joins our panel of consulting editors this month. He will contribute to the "Code Forum" department of *Electrical Construction and Maintenance.*

Mr. Hewitt is an acknowledged authority on the National Electrical Code and electrical inspection procedures. His background of 25 years in the electrical industry includes experience as a wireman, estimator, electrical contractor, and chief maintenance electrician. In 1949 he accepted the position of chief electrical inspector for the State of Washington. Previously, he had been an electrical inspector for the City of Seattle, and had also served as a member of the Seattle Electrical Code Review Board.

The State of Washington requires all electrical contractors within the state to be licensed and bonded, and the State Code is based on the latest edition of the NEC. Much of Mr. Hewitt's activities concerns code interpretations and inspection policies in the State of Washington.

LaFehr Named IAEI Managing Director

L. E. LaFehr, chief electrical inspector, Alhambra, Calif., has been appointed by the IAEI Executive Council to the newly created post of Managing Director of the International Association of Electrical Inspectors. He is scheduled to assume his new duties August 1 at the Association's Chicago headquarters.

A native Californian, Mr. LaFehr has spent most of his career in the electrical field. Born in Los Angeles, he attended public schools in several southern California cities; was graduated from Fremont High School; attended the University of Southern California.

He began his electrical career in 1926 as an apprentice electrician. Subsequently he gained experience as an electrician, electrical estimator and superintendent. Among his employers were the County of Los Angeles and several southern California electrical contractors.

During World War II, Mr. LaFehr was a Chief Electrician's Mate in the United States Naval Reserve. He served in the Sea Bees and was assigned to Ship Repair Service. While in the Navy, he taught basic electricity at the Algiers Naval Station in New Orleans. From 1957 through 1959, he lectured on the National Electrical Code at Pasadena City College.

In 1947, Mr. LaFehr joined the City of Alhambra Building Department, Electrical Division, as an electrical inspector and became an active member of the IAEI. Through his active interest in IAEI affairs, he gained prominence in local, sectional and international IAEI levels. He is a past-chairman of the Southern California Chapter; a past-president (1953) of the Southwestern Section; and since 1954 has been secretary-treasurer of the Southwestern Section, IAEI.

L. E. LaFEHR has been appointed managing director of IAEI

Since 1960, Mr. LaFehr has served the IAEI as a member of Code Making Panel 11 where he is chairman of a technical sub-committee studying multi-speed and part-winding motors for the purpose of establishing future code rules.

In 1961, the board of directors of the National Fire Protection Association appointed Mr. LaFehr to the National Electrical Code Correlating Committee.

IES Evaluates Lighting For Leisure

The Illuminating Engineering Society held its 1962 Northeastern Regional Conference June 10-12 in the Hotel Thayer, on the grounds of the United States Military Academy at West Point, N. Y. Devoting its technical sessions primarily to "Lighting for Leisure," as a conference theme, it attracted an attenddance of over 200 members and guests, from New York State, New Jersey, and New England. As usual, the conference program included both technical sessions and a round of social functions, which kept those registered for the two-day meeting fully occupied throughout their short visit.

A highlight of the conference was an address by the Society's national president, James R. Chambers, sales manager, Appleton Electric Co., Chicago. In his address, Mr. Chambers praised the country for its educational system, both public and private, but pointed out that the most critical problem in the schools is the lack of adequate classroom lighting. "With new schools by the score going up throughout the country, nearly 75% of all usable classrooms have substandard seeing conditions," Mr. Chambers said.

The IES, in collaboration with the American Institute of Architects and the National Council for Schoolhouse Construction has recently completed a new *School Lighting Guide,* Mr. Chambers reported, designed to help school boards and school administrators provide illumination that will help pupils to see efficiently and comfortably.

IES PRESIDENT James R. Chambers tells delegates to the 1962 IES Northeastern Regional Conference, held at West Point, N. Y., that 75% of America's school classrooms are inadequately lighted. He also reported that IES in cooperation with AIA and National Council for Schoolhouse Construction, has recently issued a new School Lighting Guide which will help in solving this problem. Also at table are (l to r): Robert L Zahour, IES Regional Vice President, and Gene G. Rae, Holophane Co., Inc., Conference General Chairman.

Mr. Chambers, who was honored at the President's Luncheon, at which he delivered this key address, was also honored by a reception, dinner, dance and entertainment on the evening of the same day.

The conference's program activities consisted of three technical sessions, each devoted to a special phase of "Lighting for Leisure," and an Applied Lighting Competition in which ten contestants each presented the solution of a lighting problem. The solution was in the form of a lighting installation which had been completed within the past 18 months.

Technical Sessions

The first technical session was devoted to lighting for sports and entertainment. The presiding chairman was Marshall N. Waterman, Westinghouse Electric Corp., and a past-president of the Society. Four speakers each covered a separate topic in this field of lighting.

R. L. Henderson, General Electric Co., discussed the lighting needs of marinas and water sports, suggested appropriate lighting techniques, and demonstrated some new lighting units which are applicable to the lighting problems involved.

Donald Brown, Crouse-Hinds Co., discussed lighting for golf, baseball, skiing, and similar outdoor sports. A new trend is that of lighting the last three holes of a golf course, he said, which extends playing time about one hour. Par-3 golf courses remain popular, he said, and discussed typical lighting layouts and types of equipment now being used.

Herbert O. Spliethoff, Public Service Electric & Gas Co., Newark, N. J., declared that night lighting of playgrounds is a good investment against accidents and crimes committed under cover of darkness. Shopping centers may also be considered in part as recreational lighting, the topic covered by him, since their uses are being expanded for bowling, trampoline courts, theatres, night shopping, etc. Thus outdoor lighting is rapidly becoming an indispensable part of America at play as well as at work.

St. John Terrell, Lambertville, N. J., and New York City, and creator of the Tent Arena Theatre, gave a most interesting discussion of theatre lighting through the ages, with emphasis on theatre lighting over the past quarter century. He urged the development of new theatre and stage lighting techniques, not an ever-brighter light source for older types of outmoded units, as has been practiced over the past several years.

"Lighting for Leisure in the Residential Atmosphere" was the theme for the second technical session. William F. Little, past-president of IES, presided.

A panel of four authorities, each representing a different phase of lighting, held a symposium on "Problems in Lighting Contemporary Multiple Dwellings." Panelists were: Myrtle Fahsbender, Westinghouse Electric Corp. (light sources); Arthur Birch, Lightolier Co. (luminaires); Fred Ginbern, Office of Robert Bieu, AIA (architects); and Mrs. Ruth Senior, vice-president, Shirley Boden, Builder

SPEAKERS at 1962 IES Northeastern Regional Conference, West Point, N. Y., on the subject of "Spectacular Lighting for Leisure" were (l to r). Robert A. Langer, Hamel & Langer, New York City —"Lighting at the 1964 New York World's Fair;" Rollo G. Williams, Century Lighting, Inc., New York City— "Lighting of World's Fairs 1940 to Date" and Samuel G. Hibben, Montclair, N. J. —"History of World's Fair Lighting, including Reminiscences of the 1939 World's Fair, New York City."

"PROBLEMS in Lighting Contemporary Multiple Dwellings" was the subject for a panel discussion at the 1962 IES Northeastern Regional Conference, presided over by (second from left) William F. Little, F.I.E.S. and past-president of the Society. Panelists were (l to r): Myrtle Fahsbender, Westinghouse Lamp Division, Bloomfield, N. J.; Arthur Birch, Lightolier Co., New York City; Mrs. Ruth Senior, Shirley Boden—Builder and Developer of Middle Income Housing, New York City; and Fred Ginbern, Office of Robert Bien, AIA, New York City.

and Developer (of middle income housing).

All panelists seemed to agree that current residential lighting practice is at a minimum in multiple dwellings, and far below the industry's technology and know-how. The point was made that FHA code minimums (which they certainly are) for lighting automatically become maximum requirements and standard lighting practice. The need is for education of the public, including the builders, and to get prospects for buying or renting to demand better lighting.

Two authorities covered other aspects of "Lighting for Leisure in the Residential Atmosphere." Richard S. Smith, International Hotels Corp., discussed lighting needs and practices in hotels and motels, and Edmund Motyka, AID, an artist and designer who approaches lighting from that viewpoint, using light as an element of decorative design, discussed lighting needs and practices for restaurants and gardens.

Finally, the second session was concluded by a progress report of residential lighting, which was presented by Lillian Eddy, Large Lamp Department, General Electric Co. New York City. Color slides, a luminous panel demonstration, and a variety of new and recent residential lighting units for both interior and exterior lighting were demonstrated and discussed.

The final technical session related to the spectacular in "Lighting for Leisure." Presiding chairman for this session was Rollo G. Williams,

SPEAKERS on the "Lighting for Leisure —Sports and Entertainment" session at the 1962 IES Northeastern Regional Conference were (l to r). Herbert O. Spliethoff, Public Service Electric & Gas Co., Newark, N. J.—Lighting for Parks, Playgrounds, Shopping Center Parking Areas, and Motels; Marshall N. Waterman, Westinghouse Electric Corp., Bloomfield, N. J. —presiding chairman; Donald C. Brown, Crouse-Hinds Co., Syracuse, N. Y.— Lighting for Golf, Bowling, and Skiing; and R. L. Henderson, General Electric Co.—Lighting for Marinas and Water Sports.

Century Lighting, Inc., and chairman of the New York Section, IES.

Samuel G. Hibben, past-president world's fairs over the past couple of centuries, through the New York World's Fair of 1939. Color slides were used, and lighting features of each fair were shown and described.

Mr. Williams covered the lighting of important fairs held since 1935, up to and including the currently-running Seattle World's Fair. These included the Tokyo Fair, the Brussel's Fair, and the Moscow Fair.

The last speaker was Robert A. Langer, of the firm of Hamel & Langer, New York City lighting consultants for the 1964-65 New York World's Fair. He gave a preview glimpse of some of the lighting effects being planned, and said that many new light sources now under development will be seen at the New York Fair, possibly for the first time. Many advancements in lighting equipment and lighting application will also be used, he predicted.

Lighting Contest

The IES-sponsored Applied Lighting Competition, an annual national contest, was also a highlight of the conference. Ten contestants, each a first-prize winner in a previously-held contest at the local Section or Chapter level, competed at this Regional conference for first place in each of two classifications—Residential, Class I, and Commercial/Industrial, Class II. These two winners become eligible to take their entry to the 1962 National Technical Conference, IES, to be held in Dallas, Texas, September 9-14, where they will compete for the first place on a national basis.

Three contestants competed in the Residential, Class I category. They were: Sidney Feltman, proxy for William Blitzer, Lightolier Co. —Lighting the 1962 Room for Tomorrow (first prize); W. C. Wilson, N. Y. State Electric & Gas Corp., Geneva, N. Y.—Lighting the Medallion Home of Mr. & Mrs. Norris Furman, Seneca Falls, N. Y. (second prize); and Donald J. Nevill, Niagara Mohawk Power Co., Albany, N. Y.—Lighting for Kotlow (speculatively built) Home (third prize).

In the Commercial/Industrial, Class II category, winners were: Sylvan R. Shemitz, C. S. Mersick Electric Supply, W. New Haven, Conn.—Relighting Synagogue for Congregation B'Nai Jacob, Woodbridge, Conn. (first prize); R. E. Smith, Sylvania Electric Products Inc., Salem, Mass.—Lighting a Spirits Shop, West Springfield, Mass. (second prize); John J. Neidhart and Theodore Ake, The Miller Co., Meriden, Conn.—Lighting for Work, Travel, and Relaxation (third prize).

EASA News

Another electrical apparatus service firm has acquired its own airplane. Pixler Electric Corp., Spencer, Iowa, recently purchased a Comanche 250 aircraft, equipped with Piper Autocontrol for flying long distances with less effort. Tip tanks add to the cruising range. "We believe this plane will help us to get more business as well as to keep what we have," reports Ivan Pixler, president.

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By fortunate coincidence, a feature story about Lincoln Electric Co.'s president, James F. Lincoln, appeared in the June issue of *The Reader's Digest*, shortly before the 78-year-old industrialist delivered the keynote address at the 29th Annual EASA Convention in Chicago. The article traced the history of the manufacturing firm's successful incentive management program.

• • • •

One of the newest repair and rewind facilities in the East was opened recently when Electric Apparatus & Repair Co., Philadelphia, moved into new quarters. The high bay, one-story shop houses facili-

INDIANAPOLIS service shop men C. W. Reifeis (left), Moran Electric Service, Inc., and A. C. Brehob, Brehob Electric Equipment, Inc., enjoy a humorous anecdote during session break at EASA Convention in Chicago.

ties designed to handle the largest of electrical equipment. The shop has a dynamic balancing machine capable of balancing a 6,000-lb. rotating element.

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A meeting of EASA chapters in the north central states will be held in Minneapolis in mid-September. Participating groups will include the North Central, Midwestern and Wisconsin Chapters.

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New York Metropolitan Chapter won the EASA membership contest for enrolling the greatest percentage of new members during the six-month period ending on March 30. Wisconsin Chapter finished second, Southwestern Chapter third, Niagara fourth, and Rocky Mountain fifth.

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Several EASA chapters will convene on September 21 in Cleveland, Ohio, for a two-day conference. Central Ohio, Cleveland, and Great Lakes Chapters are the sponsors of the meeting, which will be held at Hotel Carter.

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EASA's two Michigan chapters, Great Lakes Chapter and Western Michigan Chapter, will hold a joint meeting in Howell, Mich., on October 15. The city is the location of the Howell Electric Motor Co., manufacturers, which plant the group will tour. Dinner will be held at the Canopy Hotel.

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W. Bruce Byrnes, president, Electric Motors, Inc., Fitchburg, Mass., was elected president of New England Chapter for 1962-63. Vice-president is John P. Lynch, Lynch Electric Co., Wrentham, Mass.; treasurer, Milton Werby, Milton Werby & Co., Boston; secretary, Hector Munro, New England Machine & Electric Co., Pawtucket, R. I.; and director, Warren Nutter, Electrical Installation Co., Cambridge, Mass.

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Robert C. Kaska, vice-president, Chicago Electric Co., Chicago, Ill., was named "Easan of the Month" for June by the special committee appointed for naming members for the monthly honor. Co-chairman of the EASA 29th Annual Convention, Mr. Kaska is a past-president of EASA's Chicago Chapter.

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A life membership in the Rocky Mountain Chapter was presented to Thomas Paul, Paul Electric Co., Sioux City, Iowa, on March 23. Mr. Paul, who represented EASA's Region 11 for six years on the EASA board of directors, was instrumental in organizing the chapter a few years ago.

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Business conditions in the Southwest, Southeast and Pacific Northwest generally are good, according to reports from EASA members in those areas. Some shops in Texas, Oklahoma, Arizona and New Mexico experienced increases in repair volume, George Kinard, Beaumont, Texas, reported, although profit margins were narrower. Despite smaller price differentials between repair costs and new equipment, Mr. Kinard said there is an air of optimism in his area. In the Southeast, F. E. Cook, Augusta, Ga., reported better business for the first part of 1962 over 1961. He expects rewinding prices, however, to remain at their present levels because of lower prices on new motors. In Oregon, Jack W. Calhoun, Coquille, said that the lumber industry, on which several shops in that area lean heavily for business, is up and about normal, although a number

TECHNICAL QUESTION is asked by Alexander Pawlicki, Hygrade Electric Co., Chicago, during technical workshop session at Chicago EASA Convention. Forum produced wide range of shop-tested methods.

EXCHANGING IDEAS on shop promotion during session recess at EASA Convention in Chicago are (L to R): electrical apparatus service shop executives Clarence Knutson, Knutson Electric, Fergus Falls, Minn.; and Robert D. Shakstad, Shakstad Electric & Machine Works, Sioux Falls, S. D.

of smaller operations have gone out of business, leaving the field to the big operators.

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Robert F. Joseph, a past-president of the Association of Electrical Machinery & Trades of Great Britain, and managing director, The Midland Electric Installation Co., Ltd., which operates three shops in Great Britain, was a guest at a meeting of New York Metropolitan Chapter on April 26. Mr. Joseph visited several shops in the New York area, escorted by EASA international treasurer Alex Shovan, Hawthorne, N. J.

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Electrical apparatus service firms are becoming more involved with the national defense effort as contracts are issued by government agencies. Hannon Electric Co., of Dayton, Ohio, is manufacturing site adaption kits for Nike missiles. In Florida, Electra-Tronics, Inc., has recently been awarded a contract to rebuild three diesel-powered generators, part of the emergency equipment for the aeronautics installation at Cape Canaveral. Electra-Tronics, Inc., with headquarters in Sarasota, operates branches in Gainesville and Cocoa. The contract also calls for inspection, maintenance and repair of the electric motors and generators at the NASA installation, according to H. H. Morgan, president.

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A Toledo motor service firm, The Kiemble Co., has expanded its territory, opening a branch office in Lima, Ohio. The firm's sales territory will cover 25 counties, an increase of eight, according to William R. Lugar, vice-president and general manager. Daniel Cassidy has been named manager of the Lima office.

DATES AHEAD

Western Electronic Show & Convention—Memorial Sports Arena, Los Angeles, Calif., August 21-24.

American Home Lighting Fixtures Month—National promotion, September 1-30.

Illuminating Engineering Society—National technical conference, Statler-Hilton Hotel, Dallas, Texas, September 9-14.

Canadian Electrical Mfrs. Assn.—Annual meeting, Sheraton-Brock Hotel, Niagara Falls, Ont., October 3-5.

International Assn. of Electrical Leagues—27th annual conference, Sheraton-Chicago, Chicago, Ill., October 3-5.

National Electrical Contractors Assn. — Minneapolis Auditorium, Minneapolis, Minn., October 7-13.

National Electronics Conference—McCormick Place, Chicago, Ill., October 8-10.

Rocky Mountain Electrical League—Fall convention, The Broadmoor, Colorado Springs, Colorado, October 14-18.

International Association of Electrical Inspectors — Chapter Meetings — **Southern Section**, Tutwiler Hotel, Birmingham, Ala., October 15-17.

Materials Handling in Canada Exposition—Automotive Bldg., Exhibition Park, Toronto, Canada, October 15-18.

Florida Association of Electrical Contractors—Annual conference (no trade show), Castaway's Motel, Daytona Beach, Fla., October 18-20.

Electrical Manufacturers Trade Show—Indiana State Fair Grounds, Indianapolis, Ind., October 23-25.

National Electrical Manufacturers Assn.—Annual meeting, Shoreham Hotel, Washington, D. C., week of November 12.

Electrical & Home Appliance Show—Balboa Park, San Diego, Calif., November 23-28.

Building Research Institute—Fall conference, Mayflower Hotel, Washington, D. C., November 27-29.

Electrical Engineering Exposition — Sponsored by AIEE, Coliseum, New York, N. Y., January 28-31, 1963.

16th International Heating & Air Conditioning Exposition—Coliseum, New York, N. Y., February 11-14.

Associated General Contractors of America—44th annual convention, Americana Hotel, New York, N. Y., March 4-7.

4th Southeastern Plant Engineering and Maintenance Exposition — Merchandise Mart, Charlotte, N. C., March 5-7.

Among the Manufacturers

Headquarters Announcements

Federal Pacific Electric Co., Newark, N. J.—Bradford J. Stimpson, commercial vice president. Also they have established a new Apparatus Div. headed by B. G. Tremblay and a new Motor Control Div. managed by Ralph J. Weiger.

Thomas Industries Inc., Louisville, Ky.—Wallace H. Dunbar, vice president for finance.

Appleton Electric Co., Chicago, Ill.—Lee Burian, manager of inventory control.

Anaconda Wire and Cable Co., Hastings-on-Hudson, N. Y.—Alfred L. Ginty, product manager—Communications Cable.

Young Spring & Wire Corp., Bowling Green, Ohio—Paul Stephens, advertising and sales promotion manager, Equipment Div.

Electric Products Co., Cleveland, Ohio—James A. Barry, vice president of administration; Joseph March, vice president of manufacturing; Richard H. Pursell, vice president of sales.

Royal Electric Corp., Pawtucket, R. I.—Kenneth R. MacLean, vice president of sales and marketing.

Garcy Lighting, Chicago, Ill.—Kenneth S. Weiss, national sales manager.

Ward Leonard Electric Co., Mt. Vernon, N. Y.—G. Thomas Holbrook, general sales manager and assistant secretary.

Sylvania Electric Products Inc., Salem, Mass.—John J. Steenken, manager, equipment manufacturer sales, Lighting Products Div.

Sola Electric Co., Elk Grove Village, Ill.—Daniel F. McNulty, lighting sales application engineer; Frank C. Elias, manufacturing manager; Alvin S. Levine, lighting product manager.

Basic Products Corp., Lake Geneva, Wis. — Herbert Pritzlaff, sales manager of original equipment manufacturer products, Hevi-Duty Electric Div.

Tann Controls Co., Detroit, Mich.—John M. Andrews, director of engineering.

Western Insulated Wire Co., Los Angeles, Calif.—Clinton G. Gerlach, chairman of the board; Edwin B. Kanner, president.

Cutler-Hammer Inc., Milwaukee, Wis.—H. E. Stephenson, controller; O. J. Reak, manager of corporate services.

Edwards Co., Inc., Norwalk, Conn.—Lee T. Chandler, market manager for institutional markets; Edwin A. Harris, Jr., market manager for original equipment, contract and government markets; Alfred B. Thomas, manager of product planning—all with Marketing Div.

Thomas & Betts Co., Inc., Elizabeth, N. J.—Edward I. Osborne, manager of product planning research.

Regional Appointments

NEW ENGLAND

Wheeler Reflector Co., Inc.: Donald B. Rosequist, Northeast regional sales manager.

Mathias Klein & Sons, Inc.: Edward Crook, district manager for New England states, Quebec and the Maritime Provinces of Canada, with headquarters in Boston.

J. A. Weaver Co.: Charles D. White Co., Boston, representative for Maine, Massachusetts, Rhode Island, New Hampshire and Vermont.

Utility Transformer and Equipment Co.: E. P. McEleney Co., Hyde Park, Mass., manufacturers agent for New England states.

MIDDLE ATLANTIC

Sherman and Reilly, Inc.: Renko Sales, Inc., Pittsburgh, representative in western Pennsylvania and West Virginia.

J. A. Weaver Co.: G. D. Harnett Co., Philadelphia, representative for Delaware, Maryland, Washington, D. C., eastern Pennsylvania and southern New Jersey.

Consolidated Pipe Co. of America: E. F. Beckley, Manhattan Sales Co., New York, N. Y., conduit sales representative for metropolitan New York, Long Island and northern New Jersey.

Murray Mfg. Corp.: John T. Catherwood, eastern regional sales manager supervising territory from Maine to South Carolina.

Miller Co.: Peter R. Steele, regional sales manager, headquartered in Philadelphia; Illuminating Div.

Utility Transformer and Equipment Co.: J. M. Donoghue and Associates, Pittsburgh, manufacturers agent for western Pennsylvania and West Virginia.

SOUTH ATLANTIC

J. A. Weaver Co.: Howard Stuphin, G. D. Harnett Co., Baltimore, representative for Maryland.

Nylok Corp.: Jake Rudisill Associates, Inc., Charlotte, N. C., sales representative for North and South Carolina.

Consolidated Pipe Co. of America: J. T. Pearson Associates, North Miami Beach, conduit representative for Florida (excluding Pensacola); Walter W. Wildeman, Atlanta, Ga., conduit representative for Alabama, Georgia and eastern Tennessee.

Mathias Klein & Sons, Inc.: Curt Hedman, district manager covering Delaware, Maryland, Virginia, West Virginia and North Carolina, headquartered in Washington.

EAST CENTRAL

Nylok Corp.: Edward F. O'Mally, Toledo, sales representative for northwestern Ohio; Carl H. Reineck & Sons, Cleveland, covering northeastern Ohio; and K & E Associates, Corinth, Miss., covering Georgia, Alabama, Mississippi and Tennessee.

J. A. Weaver Co.: Karl E. Eggenspiller, Louisville, representative for Kentucky.

Appleton Electric Co.: Michael F. Vaughan, regional manager, east central district.

Fasco Industries, Inc.: Robert F. DeMeyer, Cleveland district sales manager.

Columbia Cable & Electric Corp.: Durnal Electric Sales Co., Muncie, agent representative for Indiana.

Consolidated Pipe Co. of America: Clyde W. Lint, Chicago, conduit representative; Clare B. Young, Columbus, conduit representative for Ohio, West Virginia and Indiana.

Leviton Mfg. Co., Inc.: Rudy C. Sheppard, sales engineer, Chicago.

Penn-Union Electric Corp.: Jay G. Gates Co., Cincinnati, representative for southern Ohio.

Square D Co.: Frank G. Howard, heavy industry control sales manager at Cleveland; Electric Controller & Mfg. Div.

Utility Transformer and Equipment Co.: C. D. Arnold, Indianapolis, manufacturers' agent for Indiana (except NW counties) and Kentucky; Dailey Engineered Electrical Products, Chicago, for Chicago and suburban area; H. Wilson Co., Moline, for northwestern Illinois and east Iowa; Electrical Sales Agency, Jackson, for Mississippi; L. Griesser Sales Co., Cleveland, for northern Ohio; A. J. Riopelle Co., Detroit, for Michigan.

WEST CENTRAL

Sola Electric Co.: Mel Foster Co., Inc., Minneapolis, representative for upper midwest.

Consolidated Pipe Co. of America: Arling D. Smith Co., Houston, conduit representative for Texas; Robert Nott Co., Tulsa, conduit representative for Oklahoma.

Penn-Union Electric Corp.: Mitchell Electrical Sales, Minneapolis, representative for Minnesota, North and South Dakota and northwestern Wisconsin.

Utility Transformer and Equipment Co.: Curt H. Conrad Co., Kansas City, Mo., manufacturers' agent for Kansas, Missouri and Nebraska Electrical Sales Agency, New Orleans, for Louisiana; Southland Sales Co., Houston, for Texas (except El Paso).

WEST

Black and Decker Mfg. Co.: Ralp[illegible]der, Hawaiian sales manage[illegible]

Jasper Blackburn Corp.: Carlson Sales, Inc., Seattle, manufacturers' representative for Washington; Robert A. Young & Co., Glendale, representative for southern California and southern Nevada.

Worthington Corp.: William M. Fine, western regional sales manager; William E. Danver, San Francisco district manager.

Sola Electric Co.: Stephen E. Speltz, western regional sales manager with headquarters in Los Angeles.

Penn-Union Electric Corp.: Robert V. Scrivner, representative for Colorado, Wyoming and eastern Montana.

Consolidated Pipe Co. of America: Sterling Equipment Co., Seattle, conduit representative for Washington, Oregon, Idaho and Montana.

Utility Transformer and Equipment Co.: Carlson Sales Co., Seattle, manufacturers' agent for Washington, Oregon, Montana and Idaho; Electric Locator and Sales Co., Albuquerque, N. M., for New Mexico, Arizona and El Paso, Texas; Control Switches, Inc., Los Angeles, for southern California; Paul S. Everley Co., San Francisco, for northern California and Nevada.

MOTOR BEARING MAINTENANCE

[FROM PAGE 98]

How do you inspect motor bearings?

When a ball bearing is removed from its housing, it should be examined for (1) contamination, dirt or corrosion, (2) excessive grease, or (3) lack of grease. Next, the bearing is cleaned with a solvent, such as carbon tetrachloride, to allow a close visual inspection. The inspection reveals the condition of the balls (or rollers), raceways and bearing housing, which often pinpoint the trouble.

If flat spots or scratches are evident on the raceway, the bearing housing may be worn or may have been improperly mounted. The presence of burned grease indicates overgreasing; powdery, carburized grease indicates lack of grease. Overheated bearing components may show a blue discoloration.

After cleaning, sleeve bearings are visually inspected for scratches and for signs of overheating. Also, the bearing fit on the motor shaft is checked. Shaft clearance should be about 0.002 in. or a little less.

Do you have any other special provisions which improve electrical maintenance?

Yes, in addition to our conventional paging system, we have an electronic coded-paging system, which has proved to be a worthwhile timesaver. The system consists of an encoder, transmitter and several small, pocket-size receivers, which are worn at the belt.

When a foreman is needed, the maintenance secretary dials the proper code on the encoder and operates a switch which causes the corresponding receiver to emit a high-pitched "beeping" sound. The foreman can then call the maintenance office to receive his message.

As chief electrician, I am almost constantly traveling throughout the plant checking electrical construction or repair work and answering trouble calls. Moreover, I am often required to be outside or in a remote area out of reach of regular paging. When an urgent call comes into the office, the maintenance secretary can immediately contact me through the electronic paging system. Thus I can quickly receive the message and dispatch electricians to the required job.

NOW IN BOOK FORM

To help you solve problems of product selection—a master reference—complete, modern, illustrated in color!

SELECTING ELECTRICAL EQUIPMENT

by J. F. McPartland and the Editors of Electrical Construction and Maintenance

This book is a modern, comprehensive manual on the selection and application of equipment for electrical power, lighting, heating, signal and communication systems. The complete, original May 1962 feature section of Electrical Construction and Maintenance is now ready. Covering generic types and models of equipment, this volume discusses construction and operation of equipment as they relate to the task of selecting the right device for any job. The presentation includes NATIONAL ELECTRICAL CODE DATA and selection information based on data from NEMA STANDARDS and UNDERWRITERS' LABS.

Chapters in the book are fully and colorfully illustrated to explain quickly and clearly the many details upon which equipment selection should be based. And the Chapters are broken down according to types of equipment to facilitate ready reference.

For the first time here is a manual which organizes into practical, usable form the key product selection facts which are available otherwise only on a hit-or-miss basis.

CONTRACTORS—Get copies of this book for your job superintendents, foremen and estimators to help them choose the right products for specific applications quickly and effectively.

ENGINEERS—This book is an encyclopedia of vital, up-to-date information on the wide range of products which go into every electrical design.

PLANT ELECTRICAL PEOPLE—This book is a "must" for all plant electrical engineers, electrical supervisors—for anyone involved in making product selection decisions.

ELECTRICAL INSPECTORS—This volume contains a wealth of important information on the safety characteristics and application suitability of electrical equipment, directly correlated with NE Code and other safety standards.

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• These manufacturers advertised their products in the ELECTRICAL PRODUCTS GUIDE ISSUE

For more complete information, and application data on their lines, refer to the index of Advertisers in the ELECTRICAL PRODUCTS GUIDE . . . the 13th issue of ELECTRICAL CONSTRUCTION AND MAINTENANCE.

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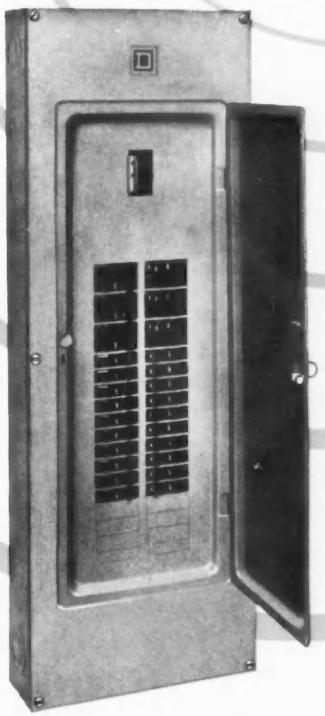

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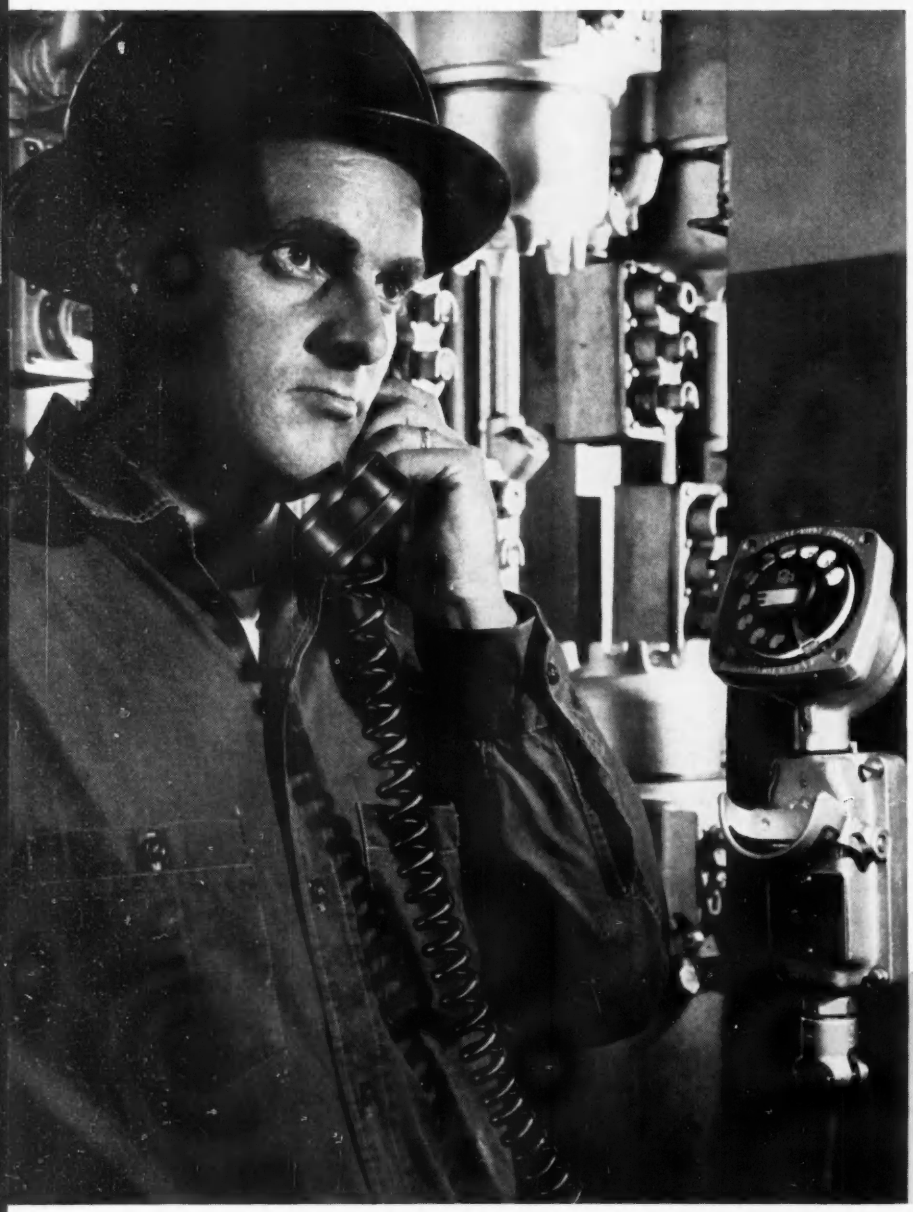

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